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ABSTRACT

This study examines the relationship of the Black Man to the profession of engineering. Chapter I discusses the background of the study, its potential value, and the long-term outlook for Blacks in engineering. Chapter II briefly describes 2 earlier studies on this subject and the institutions from which data was obtained. Chapter III presents enrollment data of engineering colleges for 1969-70, and makes comparisons of enrollments over the period 1955-70. Comments of college administrators on special programs for Blacks, supply of black applicants, employment opportunities, financial aid, secondary school preparation, and student success are also included. Chapter IV presents enrollment information of technicians institutes and administrator comments on employment opportunities, shortage of students, lack of interest, students' preference for 4-year colleges, inadequate high school preparation, quality of students, and remedial programs. Chapter V discusses engineering education in predominantly Negro colleges, and the comments of the deans of these institutions on their programs, opportunities for Blacks, women engineers, and what can be done to aid Negro engineering education. Chapters VI and VII present information on the background, education, employment, satisfaction, and salaries of Black engineers and technicians, and their comments on the job situation. Chapter VIII presents a summary and recommendations. (AF)

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OPPORTUNITIES FOR BLACKS
IN THE
PROFESSION OF ENGINEERING

by

Robert Kiehl

NEWARK COLLEGE OF ENGINEERING
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OPPORTUNITIES FOR BLACKS
IN THE
PROFESSION OF ENGINEERING

October, 1970

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CHAPTER I

INTRODUCTION

A. BACKGROUND

During the past two decades America has taken increasing interest in the changes of the status of its black citizens. The progress made by the American Negro in public service, and in private careers, has been studied and reported. This includes information on blacks in the various professions. However, the status of blacks in engineering has not been as fully studied or reported as has the status of blacks in some of the other occupations.

During the early emergence of the black from more segregated conditions he found that for him most of the professions were "ghetto" occupations. Negro doctors, dentists, lawyers, clergy, and to a lesser extent teachers, worked mainly with Negro patients, clients, parishioners, or students. This is not as true in engineering where industrial opportunities are chiefly dominated by white employers and managers. It is the relationship of the Negro to the profession of engineering which is the subject of this current study. The Negro's employment in engineering, the type of work he performs as an engineer or as a technician, his salary status and his job satisfaction were studied so that summarized information might become more readily available to Negro youth, to guidance organizations, to colleges, to the Federal Government, and to private firms.

Data were collected for this national study mainly by quesionnaires to the administrators of 263 engineering colleges and of 680 technician training institutions. The opinions of 295 black graduates of 1968 and 1969 from these institutions were sought. Each of the 7 predominantly black colleges offering engineering courses in the United States was visited.

B. POTENTIAL VALUE OF THIS STUDY

There is general value to any serious study that supplies useful data on even one small aspect of America's complex and vexing problem of race relations. However, there are more specific values to be expected.

Utilization of manpower. Administrators who have the responsibility for staffing their organizations' programs must have accurate information on available technical personnel. They are dependent on such information in locating plants and research facilities and in planning training and educational programs.

Manpower planning. Those men in the government, in professional societies, and in industry who plan for the larger, long range aspects of manpower utilization, in other words, those who plan for the changing needs of

America's increasingly technical and scientific society, need accurate and up to date information. The "Negro Potential"[1] is great, and it is as important for all America that it be realized as it is for the blacks in our society.

Guidance. The informal and formal processes by which America's youth acquires information and misinformation on educational opportunities and employment opportunities are complex. Guidance of black youth is especially difficult and the American Personnel and Guidance Association has recently devoted an entire issue[2] of its journal to this subject, emphasizing the many deep seated psychological barriers that there are to understanding and trust between white counselor and black student. Older members of the Negro community have long memories and can remember relatives or friends who earned scientific or specialized college degrees in the past and then could not obtain employment commensurate with their skills and education. Surely guidance of today's black youth should be based as much as possible on accurate, current, and realistic information.

Career conferences for freshmen. Such organizations as the National Urban League need accurate information on which to base the career conferences that are conducted at predominantly black colleges to help freshmen make the educational choices that will enable them to meet the demands of the labor market on graduation.

Curriculum planning. The National Urban League also works with black colleges' curriculum committees to help assure that the planning of program offerings is up to date with changing opportunities.

Black youth. The ultimate gainer from this study should be black youths who will have more accurate and up to date information available about opportunities for education and for employment in the profession of engineering.

C. LONG RUN POINT OF VIEW

The long run prospects of employment opportunities as well as the immediate employment market are a legitimate concern for the youth considering an engineering career. This prospect was discussed in the U.S. News and World Report in May 18, 1970.[3]

> Hiring of graduates in engineering leveled off this year, but a survey indicates employment in that field will continue to grow, though at a slower rate than in recent years. The Engineering Manpower Commission estimates that total engineering employment, compared with 1969, will be up 3 percent in 1970, 10 percent in 1972, 22 percent by 1975.

The long term outlook for engineering employment was discussed in the Manpower Report of the President which was prepared by the U.S. Department of Labor and transmitted to the Congress March 1970. After comment on short-term fluctuations the report stated "In the longer view, however, the outlook is for strong growth in requirements for scientists and engineers."[4] This document showed that the

National Goals project estimated a heavy demand for engineers while "The Department of Labor's projections of manpower requirements also indicate rapid long-term growth in demand for engineers and scientists, though not at the pace called for by the National Goals study."[5] Reference is then made to "projections of earned degrees by the U.S. Office of Education (that) indicate an annual average of about 43,000 new engineering graduates with bachelors degrees over the 1968-80 period - implying that over the period as a whole, the supply of engineers will fall slightly short of demand."[6]

Also included in the Manpower Report to the President is the following statement on still another government estimate of engineering manpower supply and demand:[7]

> The Commission on Human Resources and Advanced Education analyzed this problem, in the context of its findings that the supply of new engineering graduates would probably fall short of the demand over the next decade - and to a greater degree than is suggested by the Department of Labor's projections.

The above refers to the demand for all engineers. However, many returns from this study indicate that the demand for black engineers is greater than the demand for white engineers. This report is concerned with the long term demand for black engineers in our increasingly technological society.

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[1] a phrase used in Eli Ginzberg, The Negro Potential, (New York: Columbia University Press), 1956.

[2] The Personnel and Guidance Journal, Vol. 48, No. 9, (May, 1970), The American Personnel and Guidance Association.

[3] U.S. News and World Report, May 18, 1970, p. 103.

[4] Manpower Report of the President, A Report on Manpower Requirements, Resources, Utilization, and Training, prepared by the United States Department of Labor. Transmitted to the Congress March 1970, p. 169.

[5] Ibid, p. 169.

[6] Ibid, p. 169.

[7] Ibid, p. 170.

CHAPTER II

DESCRIPTION OF THREE STUDIES

The writer has undertaken 3 studies of the Negro in engineering. The first was made in 1955-56 and provided the data for an unpublished doctoral thesis.[1] That study was reported in 3 articles.[2,3,4] The 2nd study was a 6 year later follow-up conducted in 1961-62 and it was reported in a journal article.[5] Articles 2,3,4,5 are in Appendix. The enrollment data in these 2 studies were limited to information from those engineering colleges accredited by the Engineers Council for Professional Development. This current, 3rd study, is based on information collected during 1969-70. Like the earlier 2 studies it includes information from the accredited engineering colleges but in addition it includes information from the unaccredited engineering colleges. It also includes information from the accredited and the unaccredited technicians institutes.

A. 1955-56 STUDY

Opportunities for Negroes in engineering in 1955-56 were studied from a number of angles. Data were collected from 4 groups of sources:

Industrial and commercial enterprises
- 19 leading companies
- 102 firms that advertised for engineers in the 41 largest American cities

Negro engineers
- 49 members of the Eastern Technical Association
- 94 members of the National Technical Association

Civic and governmental organizations
- 16 state Fair Employment Practice Commissions
- 60 local offices of the National Urban League
- The headquarters of the National Association for the Advancement of Colored People

Educational and professional institutions
- 150 accredited engineering colleges
- 71 Howard University engineering students
- 112 high school counselors
- 9 engineering and professional societies

The overall findings of this study were very encouraging for the Negro considering an engineering career. There were widespread educational and employment opportunities for blacks in engineering but because to that date relatively few had availed themselves of these opportunities the Negro was woefully under represented in the profession. For example, the 1950 U.S. Census showed that there was 1 Negro engineer in the U.S. for about every 300 white engineers. The returns for the study indicated that the engineering colleges had 1 Negro student for approximately 150 white students. Those Negroes who had engineering degrees and had remained in engineering were mainly employed in research and design functions. Fewer were in production work and none was in sales.

B. 1961-62 STUDY

This follow-up was limited to a study of engineering enrollments by race. It was shown that during the 6 year interval there had been a 48 percent increase in the enrollment of blacks in engineering colleges. At this time there was 1 Negro student in the engineering colleges for about 100 white students. This relatively high increase in percentage lost some of its significance as the numbers of black engineers were small -- only 1/10th of what they would have been if Negroes were in engineering in accordance with their percentage of the total U.S. population.

A comparison of the enrollment figures of the first 2 studies showed that in the 1st study the ratio of the Negro engineering students to all students dropped progressively and sharply from freshman to senior year in 1955-56 while in 1961-62 the drop was much less severe. These figures are shown in Table 2 in Chapter IV. While caution should be used in interpreting these figures there is a strong indication that the drop out rate of the Negro had changed markedly for the better in the 6 year period.

C. 1969-70 STUDY

This current study has 3 main parts. The 1st is an enrollment study of engineering colleges and technician institutes. The 2nd part consists of employment data supplied by 1968 and 1969 black graduates of the 4 year and the 2 year programs. As the predominantly black engineering colleges are so important in the total picture visits were made to each of the 6 such institutions in the United States. Information gathered in this fashion forms the 3rd part of this current study. This study builds on the 2 earlier studies so as to provide a 3rd "point on the curve" of black engineering enrollments.

1. Enrollment data. There are 4 groups of institutions from which enrollment information was sought by questionnaire. They are:

a. The 181 Institutional members of the American Society for Engineering Education that are located in the United States and that have undergraduate curricula at least 1 of which is accredited by the Engineers' Council for Professional Development. This list is to be found in the October, 1968 issue of the Journal of Engineering Education, page 215d.*

b. The 82 Affiliate members of the American Society for Engineering Education that are located in the United States. These are institutions, each of which is accredited by a major regional educational association but not by the Engineers' Council for Professional Development. This list is on page 224d of the journal cited in "a." above.

*Note: There is 1 exception on this list. One predominantly Negro engineering college was accredited when this study was started but it's name was not on the "a." list due to the time lag. For this study this institution was removed from the "b." list and placed on the "a." list.

c. The 55 Technical Institute Members of the American Society for Engineering Education. These are 2 year institutions each of which has at least 1 technical institute curricula accredited by the Engineers' Council for Professional Development. The 18 branches of a state university were included in this group and considered separately. This list is on page 223d of the journal cited in "a." above.

d. The 625 two year institutions in the United States which do not have Engineers Council for Professional Development accreditation. The names and addresses of these institutions were supplied by the Engineers Joint Council in New York City.

Copies of the enrollment questionnaires and the covering letters are in the Appendix.

2. Employment data. Employment data was obtained from 1968 and from 1969 black graduates of B.S. programs and from 1968 and 1969 black graduates of technicians programs. This information was obtained by questionnaire, copies of which, with the covering letters, are in the Appendix.

Some of the names of the recent black graduates were obtained by requesting these of the deans of some of those institutions whose returned enrollment questionnaires showed Negro undergraduates. The administrators of some of the institutions preferred to mail the questionnaires direct to their graduates with the returns to be mailed to the writer.

This procedure was followed in some cases. About 55 percent of the useable returns were from Negroes from predominantly Negro institutions and the other 45 percent were from Negroes from the predominantly white institutions.

3. Predominantly Negro colleges with some engineering enrollment. There are currently 6 predominantly Negro colleges in the United States that are graduating men with B.S. degrees in engineering and these represent an extremely important segment of the population being studied in this report. Each of these institutions was visited during 1969-70 academic year and an interview was obtained with the dean of engineering. These institutions are:

Howard University, Washington, D.C.

The North Carolina Agricultural and Technical State University, Greensboro, North Carolina

Prairie View Agricultural and Mechanical College, Prairie View, Texas

Southern University and Agricultural and Mechanical College, Baton Rouge, Louisiana

Tennessee Agricultural and Industrial State University, Nashville, Tennessee

Tuskegee Institute, Tuskegee Institute, Alabama

D. ORGANIZATION OF REMAINDER OF REPORT

A detailed description and analysis of the findings of this report is to be found in the chapters that follow. Chapter III, enrollment information from engineering colleges. Chapter IV, enrollment information from technician institutes, Chapter V, information from the deans of predominantly Negro engineering colleges. Chapter VI, information from Negro engineering graduates. Chapter VII, information from Negro technician graduates. Chapter VIII is devoted to Summary and Recommendations that come from this study. Chapter IX is the Appendix.

As noted on pages 10 and 11 there are 4 types of engineering and technician institutions that are studied. In the chapters that follow salary information is summarized for each of these institutions so that comparisons can be made. However, in all other respects the information from the accredited and the unaccredited engineering colleges is lumped together and so is the information from the accredited and the unaccredited technician institutions. This was done to simplify the presentation of this portion of the report.

The terms "Negro" and "black" are used interchangeably. Only U.S. Negroes are studied.

The word "predominantly" is sometimes not used where it is understood. A "white" college is always a predominantly white college and a "black" college is always a predominantly black institution.

E. FINDINGS

A quick, overall summary of some of the most important findings of this report shows that time alone is not increasing the representation of the U.S. black in the engineering profession. During the last 8 years there has been virtually no increase in the percentages of blacks in engineering education except for the special programs that some colleges have instituted to encourage and to retain these students.

About 2 percent of all engineering students in the U.S. are black. The percentage of blacks in Bachelor of Technology programs is about 5 percent as is also the approximate percentage of blacks in technicians programs.

There seems to be no question but that there are widespread education and employment opportunities for blacks in engineering and in technicians' work. About half of the black engineering students are in predominantly black colleges that have engineering programs which illustrates the importance of these 6 colleges. Much of the demand for black engineers and technicians has come through government fair employment regulations. This has resulted in some dissatisfaction among engineers and technicians who feel they have been hired for their color.

The relative lack of information on engineering coupled with employment discrimination of the past seem to be the chief reasons for the apparent lack of interest of blacks in this profession today.

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[1] Kiehl, Robert. Preparation of the Negro for his professional engineering opportunities. Unpublished doctoral dissertation, Rutgers University, 1957.

[2] Kiehl, Robert. Opportunities for Negroes in Engineering, Personnel and Guidance Journal, November, 1958, pp. 219-22.

[3] Kiehl, Robert. A minority group as a source of engineering manpower. Journal of Engineering Education, April, 1958, pp. 608-10.

[4] Kiehl, Robert. Negro Engineers and students report on their profession, The Journal of Negro Education, Spring 1958 Issue, pp. 189-94.

[5] Kiehl, Robert. Opportunities for Negroes in engineering -- a second report, Personnel and Guidance Journal, June, 1964, pp. 1019-20.

CHAPTER III

ENROLLMENT DATA, ENGINEERING COLLEGES

A. ENROLLMENT DATA OF ENGINEERING COLLEGES, 1969-70

This chapter is devoted to a study and analysis of the enrollment of Negro engineering students in the United States. The information is based on the returns of questionnaires that were sent to the deans of engineering of the 263 engineering colleges listed in groups "a." and "b." on page 10 of this report. Most of the colleges are 4 year institutions although some have 5 year engineering programs.

The accredited group (a) is the larger as it reported on 114,736 students and the unaccredited (b) reported on 11,262 students. The lack of accreditation has not prevented the black graduates of those colleges from being accepted in prestigious graduate schools or from finding engineering employment at large and well known companies.

Table 1 is based on replies from both the accredited "a." group and the unaccredited "b." group of colleges in order to simplify the presentation of the results and to avoid having 2 tables of similar results. Later in this report (Chapter VI) salary information will be reported separately for the accredited and the unaccredited groups but this will be the only exception to reporting on the groups jointly.

Table 1

SUMMARY OF ENROLLMENT INFORMATION SUBMITTED BY ADMINISTRATORS OF THE INSTITUTIONAL (accredited) AND AFFILIATE (unaccredited) COLLEGES OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION, 1969-1970

Total number of engineering colleges	263	
Number of answers	222	(84%)
Number of schools that answered but gave no data on B.S. programs	71	(27%)
Number of schools that answered and gave all or some information	150	(57%)
Total number of engineering students reported	125,998*	
Total number of black engineering students	3,418	(2.7%)
Students reported by years 1 thru 5		
1st year, all students	34,262	
1st year, black students	1,226	(3.6%)
2nd year, all students	25,698	
2nd year, black students	829	(3.2%)
3rd year, all students	24,722	
3rd year, black students	549	(2.2%)
4th year, all students	24,725	
4th year, black students	524	(2.1%)
5th year, all students	3,179	
5th year, black students	25	(0.8%)
Total, all students, 1 thru 5 incl.	112,586*	
Total, black students, 1 thru 5 incl.	3,153	(2.8%)
Black students listed by field of engineering		
Chemical	58	(2.5%)
Civil	218	(9.5%)
Electrical and electronic	927	(40.4%)
Industrial	66	(2.9%)
Mechanical	386	(16.8%)
Mining	1	(0.04%)
"Other" including "undesignated"	639	(27.8%)
Number of colleges reporting data on Bachelor of Technology programs	17	
Number of Bachelor of Technology students reported	5,192	
Number of black students reported	253	(4.9%)
Number of black women students reported	79	
Black women as a percentage of all black engineering students		(2.3%)

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*The "Total number of engineering students reported" figure does not agree with the "Total, all students, by years 1 thru 5 incl." as some colleges submitted the information for the whole college and did not break the information down by years.

In interpreting the data in Table 1 it must be remembered that the figures in the table come from colleges that enroll just over half of the engineering students in the United States and that half contains all of the predominantly black colleges with some engineering enrollment.

What about the colleges with slightly less than half of the engineering enrollment in the country and that did not submit detailed data? It cannot be assumed that because they did not answer they have few or no black students. On the other hand they most certainly have a smaller percentage of black students as there are no predominantly black colleges in the group.

The table shows that 2.8% of all the engineering students are black. This figure is based on the colleges that reported and as the colleges that did not report are all white colleges it is too high an estimate to be used for all of the engineering students in the United States. The adjusted estimate for black engineering students in all of the engineering colleges in the United States is 2.0%.

Using the figure of 40,000 Bachelor of Science in engineering graduates in 1970 (this figure checked with the Engineers Manpower Commission) then a conservative estimate is that there will be about 750 blacks graduating with the Bachelor of Science degree in engineering from all of the colleges in the United States in May and June of 1970.

About 45 percent of these will graduate from the predominantly Negro colleges with some engineering enrollment.

A comparison of blacks in the present 4th year classes with those in the 3rd year indicates that there will probably be slightly fewer blacks graduating in 1971 than in 1970. This seems likely as there are only slightly more black juniors than there are black seniors at present (1969-70) and normal attrition will probably result in fewer black graduates from this present junior class.

There is another way of looking at the enrollment figures reported in Table 1. The table lists the number of black students by year. For example, in the first year there were 1,226 black students reported. From the returns it is known that 653 of these students were enrolled in the black colleges. That leaves 573 black students in the first year of the white colleges that reported. The 573 black students are 1.7% of all the students reported in the white colleges. Figuring this way for the five college years we get the following information:

Percentage of black students
in white engineering colleges by year

1st year	1.7%
2nd year	1.2%
3rd year	0.8%
4th year	0.7%
5th year	0.8%

The weighted average of all of the black students in the white colleges is 1.13%.

This illustrates the extremely thin scattering of black students among the many white institutions.

The present freshman and sophomore engineering classes have higher percentages of black students. This is due almost entirely to the special programs that have recently been innovated, at some colleges, for minority youth. This increase in the black students in the first 2 years might result in graduating classes starting in 1972 containing larger numbers of black graduates. This is speculative as it depends on the degree of success that engineering colleges have in recruiting and retaining black youth in these new programs.

The distribution of the black graduates among the various branches of engineering is similar to that for all engineers. Electrical engineering is the most popular branch of engineering for both blacks and whites but there is a higher percentage of blacks in this branch than there is of whites. The reverse is true in chemical engineering where the percentage of whites is considerably higher than that of blacks.

A little more than 2 percent of all of the black engineering students are women.

The figures for the Bachelor of Technology students are of interest for the purpose of this report. There has been an increase of interest in Bachelor of Technology programs in the last decade. This degree represents a more basic and less scientific course of study than that for the Bachelor of Science degree in engineering. The total number of Bachelor of Technology students reported is 5,192. While this number is not large when compared to the 125,998 students reported to be in Bachelor of Science programs in engineering, the percentage of blacks in the program is higher. Almost 5% of the Bachelor of Technology students are black. This percentage compares with the 2.7% of the black students reported to be in the Bachelor of Science in Engineering programs.

B. COMPARISON OF ENROLLMENTS OF ACCREDITED ENGINEERING COLLEGES, 1955-1970

One of the values of this report is that it affords a comparison of the enrollment of Negroes in accredited engineering colleges over the fifteen year span from 1955 to 1970. This comparison was first reported for studies in 1955-56 and 1961-62 in an article by this author (see page of the Appendix). Table 2 reprints this information and it compares the data with that from this current 1969-70 study. In addition a further comparison is made with the current data to show the positive effect on total picture of Negroes in engineering that comes from including the figures from 2 recently accredited black colleges.

In examining the "A" line of Table 2 it can be seen that in 1955-56 there was 1 black engineering student for every 102 engineering students in the freshman year. In the senior year this ratio had diminished to 1 black to 236 white students. Six years later as shown in the "B" line of 1961-62 students the ratios had changed and were more favorable to the black students. In the freshman year there was 1 black to 92 white students while in the senior year it was 1 black to 102 whites. Although it could not be proven this improvement was probably due to greater staying power in engineering education of the black student -- an improvement in drop out rates or an indication of less switching to other curriculums. This improvement was the main factor in a 48 percent increase in blacks in engineering education.

The improvement in the figures for 1961-62 over 1955-56 was shown to Dr. Robert C. Weaver in 1964 when he was Administrator of the Housing and Home Finance Agency. He commented "I think, in a nut shell, it represents the general picture, which is encouraging if viewed historically, and discouraging if looked at from a point of view relative to participation in the current economic climate." This comment seems as valid today as in 1964.

The comparisons described above of the information in lines "A" and "B" in Table was for 66 identical accredited engineering colleges that gave detailed information on enrollment by year. Howard University was the only predominantly Negro college with some engineering enrollment that was accredited and therefore included in this group. In this third and current study 100 colleges gave detailed statistics by year. This group of colleges now included Greensboro and Tuskegee as well as Howard as accredited colleges. However, in order to make the information on line "C" of the table from colleges as similar as possible to those whose information is listed in lines "A" and "B" information from Greensboro and Tuskegee was not included.

Table 2

ENROLLMENT OF COLLEGE STUDENTS IN ECPD ACCREDITED ENGINEERING COLLEGES SHOWING RATIO OF NEGRO TO ALL OTHER STUDENTS AND COMPARING THE FIGURES FOR THE ACADEMIC YEARS 1955-56, 1961-62, and 1969-70

	1st yr.	2nd yr.	3rd yr.	4th yr.
A. 1955-56 ratio of Negro students to all other students	1/102	1/168	1/210	1/236
B. 1961-62 ratio of Negro students to all other students	1/92	1/94	1/97	1/102
C. 1969-70 without Greensboro and Tuskegee ratio of Negro students to all other students	1/46	1/64	1/92	1/117
D. 1969-70 including Greensboro and Tuskegee ratio of Negro students to all other students	1/36	1/45	1/61	1/72

In examining the "C" line and making comparisons of the enrollments in 1969-70 with the enrollments shown for the two earlier studies it will be seen that there has been a considerable increase in blacks in the engineering colleges represented in the freshman and sophomore years. This apparently is the result of the special programs some colleges have inaugurated to encourage the enrollment of minority youth in engineering programs. The third year figures of line "C" show only a slight increase in blacks during the eight year period between the 2nd and 3rd study. The figures for the 4th year of 1 black student to 117 whites are disappointing in that the ratio of blacks to whites shows a drop and not the increase that might be expected with the passage of time. One of the largest black colleges had a relatively small class of seniors and this caused the ratio of blacks to whites to drop for that year.

The "D" line showing figures based on the same colleges as are represented in the "C" line plus Greensboro and Tuskegee was included to show the marked influence that the black colleges have on these enrollments. Aside from the blocks of Negro students that are in the Negro colleges Negro engineering students are scattered widely throughout the colleges of the United States and in small numbers.

C. COMMENTS OF COLLEGE ADMINISTRATORS

The questionnaires to the administrators called for comments "on blacks in engineering education and employment". The replies are grouped under several subject headings for ease in comparison.

Special programs for blacks. Thirteen of the engineering deans reported that they have special programs for blacks at their institutions. Some of the programs go beyond just attracting more black applicants and include summer instruction before the freshman year, tutoring, special counseling by black personnel, financial assistance, and sometimes especially arranged schedules. While the general tenor of the comments is hopeful and optimistic there are three, listed at the end, that refer to problems.

> We began a special program for freshmen in Fall 1968 to attract and retain more Black Engineering Students. Program includes a 10 hour job in engineering, (with pay) tutorial assistance (if needed), and a one to one relationship with a faculty member. Results to date show promise.
>
> Our black enrollment has essentially doubled in the past year due in part to a University-wide Special Student Program to recruit minority students...
>
> This year for the first time, the School of Engineering initiated a recruitment program to bring in disadvantaged students, particularly ethnic minorities....eight minority students began study in engineering, all receiving help and financial aid.
>
> New program of summer remedial and tutorial for disadvantaged seems to be quite successful.
>
> If funds are available we will conduct a tutorial program for these students during the summer. In any event we will give them a shortened program as a means of assisting them to be successful in adjusting to the challenges of the engineering program.

> We are anxious to hire black engineering faculty members. We are experimenting with a High School program for black students aimed at developing their motivation and background for engineering.
>
> ...is actively seeking black undergraduates, for engineering as well as other fields.
>
> We have currently active special program for increasing number of blacks.
>
> We hope to have about 40 black students in next year's freshman class. (This quotation from the dean of an urban institution that has a well rounded program.)

Not all of the replies were as optimistic as those quoted above. The following three are examples.

> We are in the fourth year of a program to attract and provide for the needs of black students at... University. Although, particularly in terms of numbers, it has been quite successful overall, the students attracted to engineering have been few and the holding ability low. Many have found greater academic success in more verbally directed subject areas.
>
> We have made some efforts to attract black students but with little success.
>
> We have a university black recruiting program which attracts some students into engineering, but they are by and large having academic difficulty.

The engineering dean of a state university described his institution's special program in detail. In includes a summer program for high school juniors and seniors on campus, correspondence with black high school students, meetings with officers of community colleges and technical institutes, special counseling, the hiring of a black admissions officer, high school programs stressing the need for black students and women in engineering, and financial assistance for black graduate students.

Supply of applicants. Seven of the deans of engineering colleges that do not have special programs for blacks stated that they have too few black applicants.

> We would like very much to have more black engineering graduates in the program but despite extensive recruiting efforts we find them to be in very short supply.
>
> There aren't enough and they are difficult to obtain.
>
> We just do not receive applications from blacks.
>
> Wish we had more black students...
>
> We would like for more blacks to indicate an interest in pre-engineering.
>
> Our regret is that we are unable to interest more Negro youth...
>
> Send us some applicants.

Employment opportunities. The comments on employment opportunities were all favorable except the last one listed below.

> There is tremendous opportunity for black students...
>
> Ample opportunities exist for enrollment of qualified black and other students in Engineering Education Programs, as well as for employment in the Engineering Professions upon graduation.
>
> Employment opportunities and placements of Black Engineers last summer were excellent.
>
> Employment outstanding.
>
> There is an unfilled need for blacks in engineering education and in engineering practice.

> They have an absolutely unparalleled employment opportunity.
>
> All graduates have assumed positions in industry or have gone to graduate school.
>
> We have had no trouble in placing black students in the past.
>
> There are many more openings than qualified candidates to fill them.
>
> I regret that many southern industries do not yet accept the black engineer completely.

Financial aid. Programs to attract minority students are costly to the college and to the student. Extra staff is needed and student scholarship aid must be provided. The following comments from white schools touch on these points.

> We have been unable to recruit any black students. We are very limited in scholarship money...We are a small school and believe we could by personal attention and the small classes help some of these students.
>
> To increase the successful participation of black students...both financial and academic supportives would be required.
>
> Academic preparation and cost of education at private engineering colleges are main problems. No problem exists with employment.
>
> The opportunities for black students in engineering education are excellent except for the need for additional financial aid.

Secondary schools. High school preparation and guidance programs drew criticism.

> ...Many blacks from the urban areas do not have an adequate educational background to enter a B.S. program due to the urban school system. Many of these students are encouraged to enter a technical A.S. degree or a B.E.T. program: However the black graduates from all programs are very much in demand in industry.

> No problem in this area in employment; however, inadequate H.S. math preparation for engineering. Some progress being made in our E.O.P. (Engineering Opportunity Program).
>
> The educational problem stems from their generally poor secondary school preparation in math and science.
>
> High school guidance is inadequate, and poor high school education keeps many black students from qualifying for engineering education.
>
> More should be done in counseling black students in High School to acquaint and encourage them to apply... There appears to be no problem placing graduates in Industry.

Student success. Two comments describe student success.

> We do not have a large number of black studnets at .... but we are in the process of seeing what we can do not only to attract them but to give any students (black or white), who have been disadvantaged because of circumstances, an opportunity to pursue higher education here. Our black students have done as well academically as other students and, as far as I know, have had no problems getting employment.
>
> Generally the black students who have been able to pass the Freshman year are above the median level in scholarship...they are sought after by industry in this area.

CHAPTER IV

ENROLLMENT INFORMATION OF TECHNICIANS INSTITUTES

Engineering technicians generally work for engineers as part of a team. They work under the direction of engineers setting up tests and experiments, taking measurements and collecting data, drafting, running control procedures, and building laboratory and pilot plant equipment. The work of technicians varies from routine tasks to working with extremely interesting, complicated, and expensive equipment on projects of importance. The nature of the work determines the desirable ratio of engineers to technicians. Without sufficient technicians on the work force the work must be performed by engineers who are paid more and who do not use their highest skills.

It is difficult for a technician to achieve an engineer's rating or to be placed on the engineering salary scale unless he obtains an engineering degree. Some credit for his technical training is usually given to the technician who is able to enter an engineering degree program.

A. ENROLLMENT DATA, 1969-1970

The technicians institutes that comprise the population for the enrollments summarized in this chapter are identified on page 11. The first group is the 55 Technical

Institute members of the American Society for Engineering Education (accredited by the Engineers Council for Professional Development). The second group is much larger. It is the 625 two year institutions whose names were supplied by the Engineers Joint Council and who do not have the ECPD accreditation of the first group. The data from these two groups were collected separately but will be presented jointly except for the average salaries which will be shown for each group in Chapter VII. None of the institutions that supplied data is a "black" school although at least one "black" institution has such a program.

The letter and follow-up letter that was sent to the technicians institutes are the same as those sent to the engineering colleges. The questionnaire is different and a copy is in the Appendix.

Table 3

SUMMARY OF THE ENROLLMENT INFORMATION SUBMITTED BY ADMINISTRATORS OF TECHNICIANS INSTITUTES, 1969-1970

Total number of technicians institutes	680	
Number of answers	546	(80%)
Number of schools that answered, gave no data or had no 2 year tech. programs	164	(24%)
Number of schools that gave all or some data	367	(54%)
Total number of technician students reported	67,567	
Total number of black technician students	3,117	(4.6%)
Students Reported by year.		
Total number of 1st year students reported	42,782	
Total number of black 1st year students	2,024	(4.7%)
Total number of 2nd year students reported	23,463	
Total number of black 2nd year students	993	(4.2%)
Number of black women students reported	111	
Black women as a percentage of all black students		(3.6%)

The data in Table 3 is relatively simple as the technician's programs are of 2 years duration, instead of 4 years as in engineering and also because there are no earlier studies available for a comparison of enrollments. Slightly more than half of the 680 institutions gave data and this (54%) showed that there is an average of 4.7 percent of black technician students which is more than twice the percent of black engineering students. The percent of black women students (3.6 percent) is higher than the percent of black women engineering students.

The returns showed that there were 993 black students in the second or final year of the programs. The probability is that if 993 black students are in the final year of approximately half of the institutions that there will be between 1,500 and 2,000 black graduates of the technicians program in the United States in June of 1970.

B. COMMENTS OF TECHNICAL INSTITUTE ADMINISTRATORS

The comments of the administrators of the technician institutes show a great scarcity of black students existing alongside of an abundance of employment opportunities. What are the reasons? Is it lack of interest of black youth or the feeling that prestige is lacking in technical work? Should blacks enter four college programs? Many administrators blame inadequate high school preparation in mathematics and science. Some conduct remedial programs and provide tutoring to counteract this while others fault the guidance counselors. The caliber of the black as a student is blamed by some but opinions vary widely on this.

Employment opportunities. The responses of the administrators indicate overwhelmingly the availability of employment opportunities for black technicians.

> There is a great need for technically trained blacks.
>
> ...there is a golden opportunity for black students upon completion of our two year programs.
>
> Industry is actively seeking black employees who graduate from our programs.
>
> ...there is an intense competition among employers for black students.
>
> Employment is plentiful. Color has nothing to do with employment.
>
> Employment potential for these students is excellent.
>
> No problems foreseen in placement.
>
> The opportunity is there.
>
> The job opportunities available for black technicians are available in large quantities.
>
> We've encountered no resistance on the part of employers to the hiring of black technicians...
>
> ...placing them after graduation has presented no problems whatsoever.
>
> Locally there are no bars to entrance in training or access to jobs.
>
> It is my opinion that the demand for trained workers in these occupations is color blind.
>
> The graduates are doing very well.

Some state that opportunities for blacks surpass opportunities for whites.

> Employment opportunities are excellent for graduates -- possibly better than for comparable whites at this time. Most of our industrial employers are equal opportunity employers with government contracts.
>
> ...we have come to believe that local industries are not only receptive to hiring black people but are, in fact, anxious to do so. A trained black person at this point probably has more employment opportunities available to him than a comparably trained Caucasian. However, the root of the problem seems to be getting black students into our programs to be trained.
>
> The Negro has more employment opportunities than white students because of the recent emphasis on helping minorities.
>
> They have more demand and will receive higher salary.

One quotation below points out that fine employment opportunities for blacks is a recent development and the last comment is contrary to all others received on this aspect as it indicates poor employment opportunities. However, there are other comments from administrators in the same southern state that this last one came from that contradict this pessimistic view.

> Local industry has only recently showed signs of changing. Technical education must join industry in trying to overcome the past, and emphasize the present and future opportunities.
>
> Employment opportunities tend to limit student recruitment.

The next few pages are devoted to further comments taken from the replies of the administrators of the technicians schools. They are under the headings of "Shortage of students", "Lack of interest", "Preference for four year college", "Inadequate high school preparation", "Guidance", "Quality of students" and "Remedial programs". While these are separate groupings they are certainly interrelated. For example, the shortage of students can be related to guidance. Inadequate high school preparation can influence the administrator's opinion of the quality of the student.

It is interesting that while several answers comment on programs such as recruiting programs that are designed to help there is little actual description of how the recruiting programs are conducted or what their scope is. Of those who commented on the quality of the students only one mentioned an attempt to measure student differences.

It is not the purpose of the author to cast doubt on the opinions of the respondents. What is intended is to point out that these are short answers (due in part to lack of space on the questionnaire form) to complex problems. Administrators are important people in the overall picture and their thinking is important.

Shortage of students.

> It's very difficult to recruit qualified Negro students in two year programs -- even with loans, grants, etc.

We're trying but are enticing too few black students into our student body. Wish we could find more.

Have difficulty recruiting black students for these programs.

We cannot get them to apply!

We have had little success in enrolling black students for any of our programs. Please let us know how we can train more black students.

...we make concerted if abortive efforts to recruit into our programs.

We are into an aggressive recruiting program to recruit blacks to move into any phase of higher education.

We regret, to our knowledge, no black students have ever applied for admission.

We are actively soliciting the enrollment of black students in both the technical and transfer engineering programs. However, we have not been very successful.

Wish there was a way to talk them into these programs. If you know of any please advise.

Since the requirements in the programs in terms of length (2 years) and entrance requirements (minimal) are not excessive they are well suited to all disadvantaged groups or anyone with limited finances. We are actively recruiting not only blacks but other minority groups for these programs. Success so far has been very limited as can be seen from the numbers.

...an honest and realistic effort is being made to inform members of the black community that these programs are available. (no students) A similar effort in the Mexican American community is producing results commensurate with the population distribution.

More should enroll.

Repeated attempts have been made to encourage blacks to enroll in Engineering Technology and other technical and vocational programs. Very little progress has been made...

> The College is exerting considerable effort to appraise black students of technical education and employment opportunities. We appear to be making some progress.

Lack of interest. The last comment of those listed below is from an educator who thinks industry has a role to play in stimulating interest.

> Unable to stimulate interest.
>
> Not much interest on the part of black students in technical programs.
>
> The employment opportunities are present, but the blacks do not seem interested in the engineering technology areas.
>
> Our campus is located on the edge of..."inner city" with a predominant black population. In spite of this our success in attracting black students into occupational preparation programs which practically assure employment upon completion has been -- and is -- most discouraging...We cannot help but wonder why more practical goals of less time for preparation, coupled with greater employment opportunities, are over-looked or by-passed by so many black students.
>
> Few black students indicate interest in the program. Industry could help by more clearly defining the need for all technicians.

Preference for four year college.

> The problem is that the capable black students are going to college rather than to a technical school.
>
> Those (black) students with a math background suitable for technical education prefer a college education.
>
> ...there is a tendency for qualified black students to aim for the professions.
>
> We have made a concerted effort to recruit black students; however, we have met with little success. The feeling seems to be that they cannot succeed without a four year education.

> In our area (southern state) "college" seems to be uppermost in the minds of students and parents. Our efforts in recruitment are coordinated with counselors and we actively and aggressively recruit in our high schools.
>
> Recruiting blacks is extremely difficult. Most blacks are pushed towards four year institutions by high school counselors and status factors.

Inadequate high school preparation. Complaints on poor preparation in secondary schools usually focus on mathematics and science courses.

> There H.S. preparatory work is generally poor; most of them require at least 8 units of remedial work before undertaking our degree courses.
>
> Most black students have a very poor background in mathematics and science. To meet this problem we are developing a remedial (pre-technical) program...
>
> We find that many of our black students do not have the Math and Science background for our Engineering Technology programs.
>
> ...poor backgrounds in math and science and have had to take Pre-Technical programs.
>
> Generally their backgrounds are inferior to whites enrolled in technical programs.
>
> Because of education background only a small percentage qualify...
>
> In general most of the black students who apply are not technologically oriented -- Math and Science background unusually weak.
>
> Generally there is a tendency for a poorer level of preparation on the part of the blacks compared to whites due to a variety of factors...

Guidance. Criticism of guidance counselors can be of two types. Some think guidance counselors do not counsel their students towards sufficient high objectives. Others complain of unrealistic guidance towards prestige programs (4 yr. Arts Degrees?) with unproven employment potential.

> We are proud to have placed the first blacks in many of the local engineering departments. Their success has encouraged our present black students to complete their studies. The reasons we do not attract more blacks are (1) lack of proper guidance at high school level (2) lack of motivation among blacks to seek careers in engineering technology.
>
> More should be done in counseling black students in high school to acquaint and encourage them to apply for programs in Engineering Technology.
>
> Our discussions with guidance teachers in the high schools indicates that very few black students, if any, take the math or science required as a high school background for admission to technology programs. My prime complaint is that the high school advisers or guidance counselors simply do not care and ignore the black students who do have the potential or the ambition. They stifle all interest and motivations by their apathy.
>
> More knowledgable counselors at High School level are needed to encourage young people (black and white) into the technical areas.
>
> They should be given more guidance as to the opportunities in these areas.
>
> I believe a large part of our problem is inadequate guidance and counseling.
>
> This year little or no black students in any technical courses...This year they (Black Students) have been counseled into the ethnic studies programs with what job opportunities????
>
> The average black student, in their efforts to seek individual and racial identity, are choosing the more esoteric fields of Drama, Writing, Psychology, Teaching, etc. There are more prestigious employment opportunities in these areas than in the areas of engineering. Instant culture is their greatest need.

> Students and parents have to be re-educated to areas of vocational opportunity. Regardless of race students and parents tend to regard technology programs as offering less in the way of achievement and prestige. There is an attitude that such a program is for those who can't compete academically. Such attitudes need to be altered.

Quality of students. The opinions of the administrators of the technicians programs regarding the quality of their black students vary widely. They seem to fall into a sort of normal curve of graded comments.

> Very fine students -- Wish we had more.
>
> The black students, who complete their training, normally rank in the upper half of their class.
>
> The blacks in this program are good.
>
> The academic and employment records of our black students are comparable to those of their white counterparts.
>
> The few we have seem to be getting along satisfactorily.
>
> The instructors indicate the Negroes do as well as other students...
>
> The students we have and have had in the past have been fairly successful students.
>
> We have seen no difference in our education program between blacks and whites.
>
> Completion percentage approximately the same as white students.
>
> We have had in the past one or two black students enrolled in a given year. None however finished the full 2 yr. program. As students none were exceptional. About 35% were incapable of doing the required work. The majority were average or a little below average.
>
> There is a high failure rate due to inadequate math background. This is slightly higher than the white failure rate.

> Our retention of black students in our Engineering Technology Program has been poor. We retain about half the white students who start and only about 25% of the blacks.

> Unfortunately, the black technical student typically lacks many of the fundamental quantitative skills which are necessary for him to experience success in engineering related courses. To my knowledge no black student has finished the two year engineering curriculum in any division.

> We have a large number of black students in the trades and services programs, however very few of them are capable of pursuing the technical courses.

> There is a large attrition rate between the first and second quarters for our black students, usually conditioned by mathematics deficiencies. This in spite of a free tutorial service available to all students.

> Most of the Negroes cannot make the required score on the Logical Reasoning Aptitude Test required for these courses. Not enough math.

Remedial programs. Some institutes have "pre-tech" programs to counter educational inadequacies. Others provide tutoring and special counseling that seems to be needed due to inferior secondary education.

> Individual tutorial help has been available since 1952.

> We have instituted a Pre-Tech program (one year preparation before entering the regular two year technician program) primarily for minority groups.

> We have just hired a black community services representative to recruit for our programs. We feel we have not met the needs of the community in this area.

> We are encouraging blacks to enter Tech. through usage of high-school tours, recruitment, and pre-tech programs for those weak in math.

> A full time Negro counselor has been employed to assist in recruiting and counseling. (southern state)

CHAPTER V

ENGINEERING EDUCATION IN PREDOMINANTLY BLACK COLLEGES

One of the most important aspects of engineering education for Negroes in the United States is the opportunity for study at predominantly black institutions. There are six such institutions, listed on page 12, that grant the bachelor of science degree in civil, electrical, mechanical, chemical, and architectural fields of engineering plus engineering physics and engineering mathematics. The northernmost of these colleges is in Washington, D.C. There is a seventh soughern institution that has an engineering program but its first B.S. in engineering students will not graduate for two years. It is not included in the discussion in this chapter even though its graduates are finding meaningful employment in industry. At least five of these black colleges have some white students in the undergraduate engineering program.

One of the six colleges is a private institution, four are state supported, and one is supported in part at least, by the Federal Government. The colleges are in or near industrial areas. The actual location of these schools is important. For example, one of the colleges is in an industrial area with no engineering college of any kind within sixty miles. Another, a division of a state university, has to compete with a predominantly white state university that has an engineering program in the same city.

Each of the colleges was visited during the 1969-1970 season. The comments of the deans ranged over a wide variety of subjects, as seen below. One of the most important was the strongly expressed and universal belief that there are widespread opportunities in engineering education and in engineering employment for blacks. The reason why there are so few blacks who have taken advantage of these opportunities was attributed to a lack of familiarity with engineering in the black culture plus relatively poor opportunities for blacks in engineering prior to World War II. There was general agreement with the idea that the federal government and industry should provide more support to black engineering education. "White" colleges can help "black" colleges (and themselves too) with cooperative programs. The general tenor of the comments was optimistic as will be seen from the more detailed reports below:

Two year technology courses. Three of the engineering deans had serious reservations about two year programs for blacks. One of these thought that due to years of conditioning that takes place as we constantly see blacks in menial jobs there would be a tendency to guide blacks toward two year programs and whites toward the four year degree programs. The other two deans who were not enthusiastic about the two year programs pointed out that the Negro needs as much education as possible to raise his status and that there is an important factor of pride in the bachelor degree among blacks. One of these pointed out that two years of education beyond high school does not usually admit a man to decision making levels.

The other three deans were not seriously concerned about two year programs for Negroes provided they were not called "engineering" and that good guidance was involved when the course of study was selected. Regarding guidance, one dean then pointed out that "Whites can't counsel blacks, but then blacks don't counsel blacks very well either"!

Reasons why Negro is under-represented in engineering. As there were no opposing ideas expressed the replies can be summarized.

In the past other professions were stressed first. It was the doctor, the dentist, the lawyer, the preacher, and the teacher who were familiar and who were emulated. These men and women lived and worked in the Negro community, but the engineer did not.

Engineering was not held in high regard. It "just wasn't the thing" to study. "Possibly this was due to the shop and plant and foundry courses that were important parts of engineering education in the past". Early engineering education curriculums emphasized foundry, shop, laboratory, and drafting work, much of which has been eliminated or reduced and replaced with the more glamorous and more theoretical mathematics and science courses as well as with studies in the social sciences and humanities.

The opportunities for blacks in fact were not good. Now that the opportunities have improved there still is real ignorance of engineering and ignorance of engineering opportunities by students and high school guidance personnel. Coupled with this is mediocre high school instruction in mathematics and in the sciences which resulted in the youths fearing the subjects that are so important in engineering.

Strongly stressed was the fact that many high school youths seek male associations and tend to get advice on what men are doing from males who are not apt to be engineers. Their teachers are usually women.

What can the academic world, the government, industry do to aid Negro engineering education? Each of the deans was asked the same question. One recurring theme is the need for more financial support from the government and from industry. This aid is particularly needed for scholarships as the demanding engineering curricula leave little time for part time work. The federal government has helped through the Aid to Education bill. According to one dean the state governments give insufficient support to the Negro institutions and industry's grants to white engineering schools in the south are more generous than those to the black schools.

A comment that was made by one of the deans in all seriousness illustrates the fact that black engineering colleges have more severe financial problems than do white colleges. In talking about exchange programs he said "If I give up a black engineering professor on such an exchange program I will need two white professors to replace him". This statement was made to illustrate how heavy the total load of a black professor is.

There has been real help for Negro colleges offering engineering programs from predominantly white colleges. This has come from the special relationships that have been made between an established white college and a developing black college. It has taken the form of visits and exchanges at all levels of administrators, faculty, and students. This has been especially helpful to the black schools as they prepare for accreditation. Five of the six southern colleges have enjoyed this relationship with white colleges from their own or other regions in the United States. According to one dean, special help is needed now in self programming methods of instruction which permits a student to proceed at his own pace without stigma.

The white academic world can help by not raiding black college faculties or students.

Industry can help by arranging bus trips to nearby plants but it must be recognized that colleges do not always have funds to pay bus expenses and that the times most convenient for the industry often conflict with the college lecture or laboratory schedules.

Possibly the most significant comment from the deans is that the industrial firm that is eager to employ black engineers is going to the wrong place when it approaches the Negro college placement office shortly before graduation time. It is expensive and time consuming and generally unproductive to just compete for the scarce "finished product". The companies should go to the high schools instead to stimulate interest there in engineering and to sponsor and support youth who are planning engineering careers. Such support could take the form of scholarship aid for college expenses and summer employment.

Graduate programs. Before 1960 there were no graduate degree programs in engineering in Negro colleges. Now these programs are starting but they are not yet a large factor in the total picture. A repeated comment was that the cost of college education is an especially heavy burden for Negroes and funds that might have been spent on graduate school work in the early working years are needed to repay undergraduate debts. Negro graduates from both the accredited and the unaccredited colleges are accepted for graduate programs in prestigious colleges throughout the country.

Women engineers. Most of the deans thought that there is a higher percentage of Negro women in engineering than there is of white women. This has been shown in earlier studies. However, the five black colleges that answered this question gave figures that totaled 3 percent women in their student bodies. If this is a higher percentage than that of white women it is not a great deal higher. One dean commented that women at his institution tended to leave early or graduate with honors.

Is the door wide open to the Negro engineer in education, employment, and professional life? This question seemed out of date and its subject is no longer an issue. No dean stated that discrimination against Negroes in engineering had completely disappeared from the land but all pointed to employment opportunities for black engineers in all parts of the United States. The only reservation was that the door is not as wide open for Negro engineers who are not U.S. citizens but these men are not included in the scope of this report.

Are there any jobs within the engineering profession for which black graduates have special advantage or aptitudes? There was just one suggestion and that was repeated. It is that wherever a building or urban renewal or highway construction or other programs impinge in any way on the Negro community the black engineers have an advantage in interpreting and predicting community reaction. They understand their own community and do have an advantage in work of this type.

The only other comment to this question was that there have been too few black chemical engineers in light of the growth of southern chemical industries. Only one of the black engineering colleges has a department of chemical engineering.

Dual degree program. One large southern predominantly white university has entered into a dual degree program with five predominantly Negro colleges that themselves offer no engineering degrees. The plan is that after three years of study at the black colleges the students will transfer into the white university's third of engineering. This extra year of preparation for the professional courses in engineering is expected to compensate for possible inadequate secondary school preparation. At the time of this investigation (the 1969-70 academic year) none of the transfer students had yet reached the white university.

CHAPTER VI

BLACK ENGINEERS SPEAK OUT

The original plan for this research for obtaining the names and addresses of recent black engineering graduates was to wait until the enrollment statistics had been received from the deans of the predominantly white colleges and then to visit those institutions that reported significant numbers of black students. Then the names and addresses of the graduates were to be requested from the deans by means of a visit.

The plan to visit the deans of some of the white engineering colleges was abandoned as no dean reported more than a few black seniors. Instead letters were written to those deans who reported any black engineering seniors. The thought was that if they had black seniors they were likely to have black graduates. Forty-five percent of the names were obtained this way. The other fifty-five percent of the names of black engineering graduates were obtained from the visits to the black colleges. Some of the deans of the black colleges sent the researcher the list of graduates as requested but others preferred to mail the questionnaires direct to their graduates themselves with the request that the completed questionnaire be returned to the researcher.

There was a total mailing of 187 questionnaires to the combined groups of engineers. Of these 23 were returned undelivered due to incorrect address or because there was no forwarding address. There were another 23 questionnaires that were returned but which could not be used as the respondents were not U.S. Negro citizens, or did not have a bachelor of science degree in engineering in 1968 or 1969. This reduced the working list to 141 names. From this list of 141 there were 103 (73%) of useable returns. There were 38 (27%) who did not reply to the questionnaire or two follow-up letters.

It is difficult to know just how much weight should be attached to comments or criticism of the young black engineers as young white engineers too are often critical of their early employment. It is a limitation of this study that it does not include responses of white engineers that could be used in comparison.

Age. The ages of the black engineers varied from 21 to 37 years at graduation. Age 25 was the average.

Sex. There was 1 woman to 102 men in the list.

Secondary school location. There were fifty-eight percent of the graduates whose secondary education was in the same state as their college. In other words, most of the graduates attended a college near their high school and home.

Branches of engineering. The bachelor of science degrees were distributed in the following branches of engineering as follows:

Electrical	47%
Mechanical	24%
Civil	13%
Chemical	6%
All others	10%
	100%

This distribution is similar to the distribution of degrees to black engineers as reported by college administrators and shown in Table 1.

Placement interviews, job offers. The number of employment interviews participated in by the graduates varied from 1 to 62. The average is 13.

The number of job offers received by the graduating engineers varied from 1 to 37. The average is 7.

It is difficult to know how many interviews a graduating engineer should take. This would vary with the students and with the type of work sought. But interviews take time and sometimes it is the poorer students who can least afford the time (especially if it interferes with classroom work) who feel the need for the most interviews. A college placement program that can help the student to understand the nature of the different types of opportunities available can help him to narrow his choices, to concentrate on preparing for these, and to save time.

Types of employment. The types of employers of the graduates follow:

Private industry	69%
Civil service	12%
Armed Forces	10%
Graduate school	7%
Teaching	2%
	100%

The most striking aspect of these employment figures is that the engineers in this study reported so many in private industry in comparison to the 1955-56 study when there were almost as many engineers employed in Civil Service as there were in private industry.

How first job was located. Most of the young engineers learned of their present job opportunity from their college's placement program but an appreciable number took jobs after graduation at places where they had had previous employment.

In answer to "How did you find out about this job?" there were the following responses:

College placement program	77%
Previous employment	14%
Employment agency	2%
Other	6%
	100%

Description of Employment. The questionnaire asked for a "brief description of work performed." The answers for industry are classified as follows:

Research	6%
Design and development	58%
Production	16%
Sales	8%
Data Processing	6%
Training programs	8%
Management	2%
	100%

Salaries. In the following survey of salaries only non-military salary figures are used.

Accredited colleges,	Range $6,500 - 12,800,	Average $10,570/yr.
Unaccredited colleges,	Range $7,800 - 12,000,	Average $10,240/yr.
Weighted average of both groups		$10,420/yr.

These figures can be compared with the national non-military salary survey of the College Placement Council which are as follows:

All male engineers, 1967-68, Average $9,192/yr.
All male engineers, 1968-69, Average $9,792/yr.

In this comparison it can readily be seen that the salaries reported by the black graduates in this study are considerably higher than those reported for all male engineers by the College Placement Council. This is a confirmation of the opinions of quite a few of the black graduates that the salaries for black engineers would be higher than those for white engineers. However, caution should be used in considering a comparison of figures such as these from two different surveys.

Job satisfaction. In response to the question "Are you satisfied with your job?" 79% checked "yes" and 21% checked "no". The stated reasons for liking the job were first "responsibility" and then the "challenge" of the work, the "opportunity to learn", the "freedom" they had on the job and the opportunity to decide on the use of their time, and also the "variety". The reasons for dislike were more varied. "Wrong location" and "amount of routine" or "paperwork" were next. Several referred to being the only black or having no black managers and a few did not like their supervision.

Level of work. The question "How much engineering is required to perform your work" and the following are the replies:

Four years of engineering college or more	68%
Some college	24%
Other	8%
	100%

At the end of the questionnaire sent to the black engineers "Comments" were requested. In considering these it should be recalled that 79 percent of these engineers have replied that they liked their jobs. Nevertheless, the criticisms expressed by these men should be carefully considered.

Comments on employment opportunities. All the evidence points to good employment opportunities and some suggests that the opportunities are better for blacks than for whites at this time.

> Employment opportunities for black engineers are very good. They are in great demand.

...field is wide open for black engineers...there seems to be a tremendous desire to have black engineers working in these companies.

Personally I think the black engineer is one of the most sought after professional men in the job market. Many companies do a lot of bending, salary-wise especially, to get a black engineer on the payroll.

The demand for technical competence usually causes companies to recruit.

...there are as many employment opportunities for the black engineers as for any engineer.

I have found them to be plentiful.

I think that there are more opportunities for the qualified black engineer than there are black engineers.

Black colleges have placement offices with excellent opportunities for young engineers.

...Employment opportunities are seemingly very good, as noted probably by the increase in the number of employment agencies catering almost exclusively to the black engineer.

The jobs are there if the person is qualified. The basic misconception is this qualification bit. I think personal traits of an individual are as important as his/her professional training. The well rounded person who is versatile for all intents and purposes can name his position.

Most of my job offers came from the government. Private consulting firms (Civil) did not interview on my campus. Large corp. hand out technician jobs with salary commensurate to engineers.

...it seems as though industries "jump" for opportunity to hire a Negro from a white college but are not so eager to hire Negroes who have finished from black colleges.

I believe employment opportunities for black engineers are outstanding, if not better than his white cohorts.

> Excellent! Black engineers, equipped with an impressive academic record and a pleasing personality, have a much better chance of receiving a better job offer and subsequent advancement opportunities than his white counterpart.

> It was my experience when interviewing that companies are extremely eager to talk and to employ black engineers. I received job offers from all of the companies I interviewed and when I was on trips to their plants I was accorded every possible courtesy. I would say that if the situation now is anything like it was when I graduated a black engineer with anything near acceptable credentials will experience no difficulties at all in finding a job to suit his tastes and desires.

> From my own personal experiences I found that being black was no obstacle to my pursuit of a career in engineering. At _____ I felt that my performance was appraised objectively and that I received recognition for all extra efforts. In interviewing companies before my graduation I received the impression that being black may have helped me in procuring offers as white classmates interviewing for the same positions were not quite as successful in landing job offers.

> I would say that employment opportunities for black engineers with superior qualifications are better than those for white engineers with superior qualifications.

> From my interview experiences I think there are many opportunities for black engineers.

> Since the beginning of the civil rights movement, employment opportunities for black engineers have reflected a steady rise.

> Employment opportunities are definitely present for those engineers with reasonable grades and who have somehow managed to obtain related experience.

Comments on Showcasing. "Showcasing" refers to hiring a man for his color to meet a company quota or to improve the company's image. Black engineers are certainly aware of this as the following quotations will show.

Now's the time to be black. Beware of "showcase" jobs that may be dead enders. Accept no job that necessitates radical changes in your ethnic pride, morals, philosophies, and basic convictions.

...one must be careful because many companies are more interested in improving their "equal opportunity employer image" than using the technical ability of black engineers.

...opportunity is not the problem. During my interviews I found myself in some situations where the salary being offered was for the color of my skin and not my degree...A black engineer has to be very careful in making a job selection.

Graduates should evaluate the possibilities of advancement. Beware of showcasing.

Jobs are available however many employers are interested in hiring black faces rather than black talent. I believe most employers doubt the abilities of a black engineer, especially if he is a graduate of a predominantly black school.

There are at this time numerous opportunities for blacks in industry but I'm convinced that a substantial number of these opportunities are because they are black. However, the need for engineers is such that most will get profitable work experience and things are steadily improving.

There were numerous opportunities for employment after I graduated. The problem was finding which employers were after engineers and which were after blacks to satisfy some quota they needed.

I feel many companies use Blacks as show niggers. Their technical astuteness is secondary. There are, however, now good opportunities for Blacks.

They are in demand...not so much because they are engineers but because they are black. Any aero space industry dealing with government contracts must acknowledge the equal opportunities program. We will be hired - as I was - with no review of background.

Upon graduation I heard numerous times "you have it made" i.e. everybody is searching for a black

> engineer. To the contrary, however, although business is searching for black engineers it has a definite quota. Subtract the "showplace" jobs from this quota and the meaningful, challenging job opportunities aren't quite so numerous. In addition, the social and political situations in this country are making business reluctant to expand, which limits all engineering opportunities. These factors make it necessary for a black engineer to compete more aggressively - be better prepared - if he is to succeed in a market that is partially, but not totally oblivious to his color.
>
> I feel that in the sense of being a token, this doesn't hold true very much any more, especially in the engineering professions, because even if a Black engineer is hired to "Sit by the door" so to speak, he is still an engineer of which there is a definite need regardless of race, creed, or color.

Comments on promotion and advancement policies.

While blacks agree that employment opportunities are good for beginning jobs they show concern for promotion policies.

> Many blacks will be hired by companies but the question is will black engineers be promoted to higher levels within the company.
>
> There is one question still not answered. How far up will the present structure allow him to travel? There are still many barriers preventing blacks in engineering from rising to his level of competence.
>
> The opportunities for black engineers are plentiful as far as engineering is concerned but I feel industry has a long way to go as for making blacks feel that the managerial jobs are available to them on an equal and competitive basis.
>
> Employer gives: (1) Lateral movements with increased salaries instead of vertical promotions with increased salary and responsibility, (2) Assignment under senior engineers for prolonged periods of time without meaningful responsibility, (3) Microscopic evaluation of the black engineer's qualifications as compared to the general evaluation of white's.

> Industry accepts the black engineer but doesn't like to hear about lack of black personnel in management levels. Industry wants the black to assimilate rather than maintain his identity.
>
> The employment opportunities are there but once on the job you are evaluated unfairly which is my case.
>
> Black engineers at _____ are limited, confined and kept in the background much more than necessary; I would suspect that this is the case in general, even when the engineer is thoroughly qualified (such as myself).
>
> I would think that opportunities are good for above average (relative to white average) black engineers; however this excludes management positions.
>
> There is an opportunity for black engineers to succeed in industry. However, they must constantly strive for excellence in their work while trying to cope with "the system" and maintain their self respect and manhood. This is at times almost impossible.

Comments on racism. What one engineer called "subdued racism" is considered a factor by others.

> Many engineering positions open to black engineers... nevertheless once a black man fills an engineering position he must take the abuse and prejudices of being a member of a minority group.
>
> It is ironic that the white man of today in the south and north is amazed that a black man, when given the opportunity, can do the required work.
>
> I always have to "Educate" other people before they are comfortable around me...They must be told that "I haven't got a tail."
>
> I think the fact still remains that the black engineer will have to be prepared to out produce his white counterpart in order to be considered for the same promotion, which I think is due mainly to the fears of the organization as to the reaction of the other employees and to public opinion.

> There is a great degree of reluctance in accepting and utilizing the knowledge and abilities of the black engineers -- In practically every occasion he has to go beyond the average white engineer to prove himself. If he accomplished this obstacle then he is feared for he becomes a threat to some complacent white engineer.
>
> Much of the acceptance of black engineers is still confined to the upper levels of management in my organization. Until this attitude progresses down to the immediate managers, and until the engineers in question have proved themselves they will still be thought of as part of a quota.

One young man received his degree, worked one summer, and then left the engineering field. He is now enrolled in a M.B.A. program. This is his comment: "I have found it extremely difficult to disassociate myself from my black brothers. To this extent, I can't relegate my social awareness and responsibility to a part time avocation".

CHAPTER VII

BLACK TECHNICIANS SPEAK OUT

It proved to be more difficult to obtain the names of black graduates of technicians institutes than it had been to obtain names of black engineers. Also the technicians did not return the questionnaires to the same degree as did the engineers. Nevertheless considerable information of value was obtained for study. As with the engineers all information is for the two groups of graduates combined (those from the accredited and those from the unaccredited institutions) except salary information which is shown for both groups, and then averaged.

After enrollment statistics were received from the administrators of the technicians institutions a second letter was sent to the same person requesting the names of recent black graduates whenever the enrollment figures showed that the institution had black students. Names were received from 14 institutions. None of the institutions that contributed statistical information was "predominantly black".

A total of 108 questionnaires were mailed to black technicians who had graduated from technician training institutions in 1968 or 1969. The names of these men had been supplied by some of the deans. Of these 21 were returned due to incorrect address or because the addressee had moved and no forwarding address was available. There were 4 replies that could not be used as they were from men who did not graduate in 1968 or 1969. These deductions gave a working group of 83 names. From this list of 83 there were 45 (54%) of useable returns and 38 (46%) that did not reply to the questionnaire or to the two follow-up letters.

Age. The ages of the black technicians at graduation varied from 19 to 29 years. The average was 23 years.

Sex. There were 6 women and 39 men in the group of respondents.

Secondary school location. Seventy-nine percent of the graduates attended technicians institutes that were in the same state as their high schools. In other words, 4 out of 5 technicians attended institutes near their homes and high schools.

Branches of technology. The graduates specialized in the following branches of technology:

Electrical	45.0%
Mechanical	35.0%
Civil	7.5%
Chemical	5.0%
Other	7.5%
	100.0%

Placement interviews, job offers. The number of employment interviews taken by the technician graduates varied from 1 to 14 with the average of 6.

The number of job offers varied from 1 to 8 and the average was 4.

Types of employment. The technician graduates reported having the following types of employment:

Private industry	83%
Civil service	0%
Armed forces	7%
College	5%
Other	5%
	100%

It is striking that there is such a high percentage in private industry and that none was employed in civil service. This could be interpreted as an indication that the plentiful jobs in private industry have more lure, which might include higher salaries, to the graduates than those in civil service.

How first job was located. The following shows the responses to the question "How did you find out about this job?"

The institution's placement service	66%
Previous employment	3%
Employment agency	12%
Other (newspaper advertisement, friend)	19%
	100%

Description of employment. Exactly half (50%) of the technician graduates stated that they were in design or drafting work. The remainder of descriptions of work performed were widely scattered among the following:

Research and design technician
Writing job specifications
Training program
Laboratory assistant

Testing
Installing controls
Computer maintenance
Repair
Checking customer complaints

Salaries. Only non-military salaries are shown as follows:

Accredited institutions,	Range $7,280 - 8,400,	Ave. $7,860/yr.
Unaccredited institutions,	Range $6,600 - 10,400,	Ave. $7,150/yr.
Weighted average of both groups		$7,420/yr.

Job satisfaction. The question "Are you satisfied with your job" was answered "Yes" by 61 percent of the technicians and "No" by 39 percent. Because the reasons given for these answers vary widely it is difficult to tabulate them by groups. "Opportunity for learning" was the most frequently stated reason, with "challenge" and "co-workers" next followed by "freedom", "diversity", and "working conditions". Other reasons mentioned included "responsibility", "evaluation by performance", "location", "opportunity", and "benefits".

Stated reasons for dislike of job were first "salary" and next that their "ability not used". Other reasons included "not enough learning", "lack of training", "company too large", "reading of drawings", "supervision", "advancement", "hours", and "routine". Several complained of poor communication with the remainder of the work group and "social barriers".

Level of work. This question for the technicians was phrased "Is the level of your work about right for the length of time you studied in your technical institute?" This was answered "yes" by 64% of the technicians and "no" by 36%.

The last question on the form sent to the graduate technicians was a request for comments on employment opportunities for black engineering technicians. The answers are presented under the headings of comments on Employment opportunities, Showcasing and Promotion. There was also one comment that could be classified under Racism.

When reading these comments it is interesting to remember that 39% of these technicians checked that they disliked their jobs. These written comments do not reflect that much dissatisfaction.

Comments on employment opportunities. The first two comments are negative.

> Most companies don't want to hire black technicians.
>
> It is hard to find a job in the field that you are in or have been trained for.

All of the other comments under this heading are favorable.

> I think the employment opportunities for black engineering technicians are so wonderful that it has given me a great sense of responsibility in our society.
>
> Open field.
>
> I think the opportunities are getting greater every year. Also, many industries are wanting qualified black engineering technicians in this area.
>
> There is an unlimited number of job opportunities for trained persons. In some ways this is better

than going to a college and obtaining a degree. You, as a technician, are on the same basis as a college graduate in many companies.

Opportunities are good for men.

I think that the employment opportunities for black engineering technicians are very good at present and in the future. I feel that they are going to get better. There will be more jobs and better pay for blacks.

I think the opportunities are surely there although I don't think all black students are oriented to exactly what these technical schools can do for their future. I say this because I only found out about this school through my brother who attended two years before I did.

Through my experience in employment I know that employment for blacks in engineering is growing all the time. I think blacks should pursue more technical fields.

Color is not an issue, performance is.

The black engineer should interview with as many companies as possible. The jobs are there but they won't find him. He will have to find them.

There seems to be a drive on to hire blacks. This is very true in the industries of most major industries.

The opportunities are good if you are good.

Make sure the technical school is capable of giving the right level of education for the field you wish to venture. Like everything else, blacks are in demand, we just have to get out and look around.

Employment opportunities are definitely open for blacks with the education in electronics.

I think that opportunities for black technicians are very good. Here they have gone to great lengths to hire as many black technicians as possible.

> A large firm will pay more but I would suggest that they enlist in a small firm. There they would learn more from professional engineers and they would not be confined to drafting.

> I believe that the black engineering technician's opportunities are greater with the larger companies.

Comments on showcasing. The following comments reflect the concern of the black technicians that some of their employment opportunities have come from companies that are interested in hiring by color.

> I feel a black person can succeed in the field of engineering if he does not accept a job which is offered as a symbol.

> The opportunities for black engineering technicians are increasing but at what I consider a snail's pace. I think that the personnel departments are still simply reaching their black quota.

> ...I feel uncomfortable at the position because I get the feeling of being a token employee - some one to show the Federal Government that one of eight engineering aides is black.

> I feel a lot of companies need blacks to say they have blacks not because they (the blacks) earned the job.

> It is becoming more of an open field for black engineers, but there are a lot of companies that are narrow minded in their beliefs and pretend not to be.

Comments on promotion policies. These five comments are from blacks who have reservations regarding their chances for promotion.

> Equal employment opportunities for us are fair; however, in some instances, salary and position (responsibilities) are not commensurate with ability and training.

> I feel black technical people are on the spot from the beginning. Most of his associates are going to expect him to be "substandard" and look for opportunities and instances to prove their point; "I told you so."
>
> Opportunities for employment are probably great - but opportunity to assume responsibility or advancement at your own pace is not always possible.
>
> I have been with this company for 1-1/2 years and have not received a raise as yet.
>
> In a big corporation like _____ it's rather hard to advance simply because there is a great deal of politics and favortism involved.

Comment on Racism. There was only one comment from a black technician that can be construed as showing evidence of racism. The technician wrote "People are reluctant to hire a black technician, no matter how well qualified, to supervise their white employees. If they do hire you they do not try to mediate, or bring about a situation where the white has to accept your decision or be fired."

CHAPTER VIII

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND POSSIBLE FURTHER STUDIES

A. SUMMARY

Hundreds of voices have been heard from all over the country almost all of which tell the same story. There is an abundance of well paid employment opportunities for black engineers and technicians and there is a corresponding shortage of trained applicants. This gap between the many jobs and the few applicants is narrowing slowly but the pace of the improvement is far too slow for our dynamic society. To show how far there is to go one need only consider that in spite of the increases in percentages there is only 1 black student to approximately 140 white students in the senior classes of the predominantly white engineering colleges of the United States.

More specific summarizations follow. Most of these are concerned with some aspect of why there are relatively few black students seeking careers in engineering and in technology.

(1) An engineering image (an understanding of what an engineer is, what he does, how and where he is educated, and what his employment opportunities are) is almost completely non-existent in the society in which many black

youths live and mature. This comes about as few of the men from whom black youth learn of occupations are engineers. There is little realistic knowledge of engineering among the teachers (mostly women) in their secondary schools. Few of the Negroes that they know in professional categories are engineers or scientists.

(2) There is a frequently mentioned belief that Negro youth have had inadequate mathematics and science preparation in high school.

(3) Adequate guidance does not reach the Negro youth early in secondary school when the choice of academic programs is vital.

(4) The predominantly Negro colleges with some engineering enrollment carry almost half of the nation's load in educating black engineers. This is due in large part to the students' belief that in these schools they will receive sympathetic treatment, personal attention, and that they will feel at home with the student body. The students feel that the faculty of the black colleges will understand if they have a lower starting point and will help to bring them up to standard in ways which they feel would not be done at what they consider to be the more impersonal white college. The black student at a white college feels himself to be in "double jeopardy", first from his relatively weak preparation in mathematics and science and secondly from the insecurity of being outnumbered 50 or 100 to 1 racially.

(5) Predominantly white colleges are developing new programs designed to bring more blacks into engineering and technician education and to help them to succeed. These programs include remedial work, special counseling, and financial aid.

(6) Links between established white engineering colleges and developing black engineering colleges have been helpful and effective.

(7) Although most black engineers and technicians like their jobs many are critical of their employers as they feel they have been hired to fill some quota. Many are suspicious that their progress in their company may be limited.

B. CONCLUSIONS

(1) The passage of time alone will not increase the entry of the black into the field of engineering at a rate acceptable to our society.

(2) Increasing the numbers of Negroes into the profession of engineering is too big a job for engineering educators alone. The most effective help could come from industrial employers. See "RECOMMENDATIONS."

(3) The benefits of the successful entry of more Negroes into the profession of engineering will not be confined to Negroes alone. The benefits would be shared by all United States citizens as we draw more fully on the black minority in our population to fill the increasing manpower needs of the profession of engineering.

(4) The goal is not necessarily to make the black in the image of the white and to think that he should be in engineering in the same percentages. The goal is to see to it that blacks understand the nature of all phases of engineering education and engineering employment so that those with the interest and the ability will be able to take full advantage of this occupational opportunity.

(5) The pressure from the Federal Government for large employers to include blacks in their engineering staffs has brought some problems with it. It has certainly increased the demand for black engineers and technicians but it has been accompanied by a feeling of resentment in some cases by blacks who feel that they owe their positions and good salaries to government pressure and not to a genuine need for their skilled services. This resentment was not apparent in the comments of engineers in studies made before the government influence for fuller employment of the black in this field was felt. The greatest help to the Negro engineer would come from a healthy economy and a continuing strong demand for engineering manpower.

(6) This study has shown that there is a serious shortage of black engineers and that there are many employment opportunities for such men. It has become apparent that engineering is a profession relatively neglected by black persons and that this under representation of the black is

part of the much larger subject of the blacks in our whole society. There cannot be complete integration and acceptance of the black into engineering until this same integration and acceptance takes place in society as a whole.

While there are no quick, easy, or cheap solutions to the problem being considered there are some specific actions that can be recommended. These are presented below under institutional headings. Some of the recommendations can be considered under several categories.

Some of the recommendations of this report are already being undertaken by some of those involved and were started before this study was made. For them these recommendations will serve as reinforcements to their efforts rather than as suggestions for new programs. The pace of improvement must be accelerated if this one aspect of our total problem of race relations is to become a bright spot rather than one more dismal part of the total picture. The goals are worthy of real effort.

C. RECOMMENDATIONS

Recommendations for industry

(1) There is something to be learned from English engineering education where "industrially based" students are an important segment of the student engineering population. A company could sponsor a black freshman engineering student. The student could be hired by the company and given educational

leave during the academic year. He could work for the company during school vacations and the company could appoint an industrial counselor to keep in touch with the student during the entire year. This might be especially effective with Negro youth who have more than their share of insecurity and who have lingering doubts about their acceptance in a company and who need to feel at home -- to be wanted and needed. If these students get to know and to like a company and are genuinely welcomed they are apt to return to (or stay with) "their" company after graduation. This is similar to aspects of cooperative education.

(2) Emphasize the need for engineers and technicians and de-emphasize hiring by color. Where a firm is making a sincere effort to increase its black employees, and in that sense is hiring by color, this could be discussed seriously with black candidates so that they understand the genuine intentions of the employers and do not feel that they are merely part of an enforced government quota.

(3) Consider the point of view of black employees who feel that their management opportunities are limited to be sure that the young men and women understand the criteria for promotion to supervisory or management ranks and the systems of evaluation that are used.

(4) Support local school systems by:

a. Encouraging the teaching of high quality mathematics and science.

b. Conduct seminars with high school guidance personnel.

c. Provide summer work for black youths who have an interest in engineering or technology.

d. Sponsor factory visits.

e. Provide a young engineer (preferably black) who could meet periodically with local high school's guidance counselors, and student groups, and be present at any career day to discuss employment opportunities in engineering and technology.

Recommendations for white colleges.

(1) Continue, increase, or start special programs designed to attract minority youth to engineering education and to help it to succeed. Enlist black counselors and advisers to aid with this work.

(2) Keep student records by race.

(3) Study intensively the reasons why black youths fail or transfer from engineering programs.

(4) Form a mutual association with a black institution so that there can be an exchange of ideas between students, faculty, administration, and placement officers.

(5) Watch the development of dual degree programs where students transfer from predominantly black colleges to white engineering colleges.

(6) Employ some black counselors.

(7) Urge black students and graduates to keep in touch with their high schools to tell the pupils about their experiences in engineering education and employment.

Recommendations for Technicians Institutions

(1) Continue, increase, or start special programs designed to attract minority youth to technicians education and to help it to succeed. Enlist black counselors and advisers to aid with this work.

(2) Keep student records by race.

(3) Study intensively the reasons why black youths fail or transfer from technician training.

(4) Employ some black counselors.

(5) Urge black students and graduates to keep in touch with their high schools to tell the pupils about their experiences in technicians education and employment.

(6) Check to learn if civil service opportunities are being neglected by graduates.

Recommendations for predominantly Negro colleges with some engineering enrollment.

(1) Continue the programs that have proven so successful in attracting and educating Negro students in engineering.

(2) Continue the special programs aimed at acquainting high school teaching and guidance personnel of the opportunities in engineering and of the need for good mathematics and science preparation in high school.

(3) Urge college students and recent graduates to return to their high schools to supply information on engineering education and employment to potential engineering students.

(4) Give special attention to college placement counseling to help members of the graduating class to use the placement services efficiently so that they will not waste time on an unnecessarily large number of interviews and so that they will understand employment relationships on the job.

Recommendations for the Federal Government.

(1) Continue to support and encourage the relatively few black colleges that have the confidence of black youth and educate almost half of the black engineers in the United States.

(2) Support the special programs that the white engineering colleges have started to assist the entry of Negroes into engineering.

(3) Make it clear to educational institutions that statistics of students by race may be kept for research purposes.

(4) Publicize the opportunities in engineering for blacks in the literature that reaches into the black communities and junior and senior high schools.

D. POSSIBLE FURTHER STUDIES

The Negro in graduate engineering education.

Management opportunities and promotional policies for blacks in industry - engineering.

Opportunities in engineering for other minorities such as Spanish-Americans and Mexican-Americans.

Image of engineering in the Negro community.

Study and evaluation of various special opportunity programs in engineering colleges and technician training institutions.

APPENDIX A

OPPORTUNITIES FOR NEGROES IN ENGINEERING

ROBERT KIEHL

A NEGLECTED area for research in the field of guidance has been that of a study of opportunities for Negroes in engineering. In 1956, however, Eli Ginzberg of Columbia University reported on a Conservation of Human Resources project in *The Negro Potential* (Columbia University Press, 1956). The under-utilization of the Negro throughout the world of work was strikingly demonstrated in this study. A national study [*1*] was completed by the author in 1957 on opportunities for Negroes in engineering. This study was conducted independent of Ginzberg's work but was a natural sequel as it examined the opportunities for Negroes in one of the professions. Its specific findings for Negroes in engineering are as favorable for the Negro as were the more general findings of Ginzberg's wider study.

With the improving position of the Negro in today's society and with the widely reported shortage of engineers, the guidance of Negroes with respect to engineering careers is an important current problem for those school counselors who deal with the minority group. It is probably more difficult to counsel Negroes in regard to engineering than it is in regard to the other professions. In the clergy, law, medicine, and teaching, the Negro has functioned within his Negro community. This is not as true of engineering, because most of today's work is in situations where the management and professional groups are predominantly white. Indeed, Negro leaders in the past have found it hard to agree on the guidance of their youth toward occupations that require long years of training. It is realized that in order for Negroes to advance it is necessary to have trained Negro youth prepared for the opportunities that are here and that are coming. Counselors, however, may be deterred by the specter of highly trained Negroes, unable to find employment commensurate with their skills, working at menial jobs.

Collection of Data

The approach to the study of opportunities for Negroes in engineering was that of the normative-survey method. Data were collected by means of questionnaires and interviews from four groups of sources: *industrial and commercial enterprises* (19 leading industrial and commercial enterprises, 102 firms that advertised for engineers in the 41 largest United States cities); *Negro engineers* (46 members of the Eastern Technical Association, 94 members of the National Technical Association); *civic and governmental organizations* (16 state Fair Employment Practice Commissions, 60 local offices of the National Urban League, the headquarters of the National Association for the Advancement of Colored People); *educational and professional institutions* (150 accredited engineering colleges, 71 Howard University engineering students, 112 high school counselors, 9 engineering and professional societies). In all, nine sets of questionnaires were utilized.

Summary of Data

Industrial and commercial enterprises. Answers from the employers of over 41,000 engineers were generally favorable for the employment of Negro engineers. The employers stressed their lack of discriminatory employment policies and also the lack of Negroes among engineering applicants. There were apparently more Negro engineers in proportion to all engineers among the smaller companies than there were in the larger companies, but in all cases the

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ratio of Negro engineers was far below the ratio of Negroes in the population. Most of them were in the electrical or mechanical engineering fields. The larger companies relied mostly on college recruiting for their supply of engineers, but the smaller companies used advertisements and employment agencies extensively as well as recruiting. Several employers expressed the opinion that Negroes in engineering would be handicapped in sales work.

Negro engineers. Information was received in the questionnaire responses of 94 male Negro engineers between the ages of 25 and 70 who were members of the Eastern Technical Association or the National Technical Association. Almost all of the men held Bachelor of Science degrees in engineering. The Bachelor degrees were from 27 colleges located in 13 states and the District of Columbia. Twenty-five of the men had additional degrees. Masters degrees had been earned at colleges in six states and in the District of Columbia.

The largest concentration of engineers was in the electrical and civil engineering fields of specialization. Mechanical engineering was the third most frequently selected field.

Most of the engineers chose the profession of engineering because of their interest in the field or their liking for the work. They expressed the opinion that their relatives had been the most important of all persons in influencing their occupational choices.

Most of the engineers liked their work and would choose engineering as a career if they had the chance to make the choice all over again. All of them would advise qualified Negro youth to choose engineering careers today, and they based this advice on today's employment opportunities.

Almost as many of the engineers were employed in Civil Service work as were engaged in private industry. The next largest group was of men in the teaching profession. Nearly all of the men stated that they were employed at the professional level. The average length of time to achieve this level of work after graduation was less than three years.

More of the engineers worked in the more theoretical functions of engineering such as research, design, and development rather than in production or distribution. None were in sales work.

The largest number of engineers located their jobs through their individual efforts rather than with the aid of their college or of a service organization.

Electrical engineering was stated most frequently as the field of engineering with the best opportunities for the future. Civil engineering was second choice.

Civic and governmental organizations. The data are summarized separately for the Fair Employment Practice Commissions, for the local Urban League offices, and for the National Association for the Advancement of Colored People.

The responses from the Fair Employment Practices Commissions from the 13 states that had such commissions in operation during the two-year period from January 1, 1954, to December 31, 1955, showed that there had been only a few charges of discrimination filed in behalf of Negro engineers during the two-year period and that none of these had resulted in a court case. The comments of the commission officials were favorable regarding professional engineering opportunities for Negroes in the various states.

The information that was received in response to questionnaires sent to the 60 local Urban League offices showed that there was a shortage of engineers throughout the United States. This shortage was most pronounced in the field of electrical engineering. The League officials reported over 300 engineers employed and only six Negro engineers unemployed in their areas. Only one official had knowledge of "qualified Negro applicants for available engineering jobs."

The Urban League officials have been active in the placement of Negro engineers, but they reported that Negro youth generally does not take an interest in engineering as a career. The League is very active in a variety of group and individual guidance programs through clubs, homes, schools, and with the general public.

In their comments, the Urban League officials gave encouragement to youth considering engineering because of the increase of opportunities and the lessening of discrimination in that field. A strong expression was made of the need for increased guidance of Negroes as regards current opportunities. According to the answers, counselors and parents of Negro pupils need current vocational information on engineering opportunities. Also needed are more adequate secondary and college training facilities for Negro youth in portions of the South of the United States.

The National Association for the Advancement of Colored People is unequivocally in favor of complete equality of opportunity, of making Negroes alert to their chances for improving employment opportunities, and of preparing Negroes more and more for jobs that have hitherto been closed to them. It was stated that the availability of college trained Negroes would greatly aid the integration of Negroes into the professions.

Educational and professional institutions. The data are first summarized separately for colleges, engineering students, high school counselors, and engineering and professional societies.

According to the information supplied by the deans of the accredited engineering colleges throughout the United States, there was one Negro student for each 152 students in the first year, one for every 234 in the second year, one for every 316 in the third year, and one for every 364 in the fourth year. The one college that was predominantly for Negroes trained more Negroes for engineering than the more than 100 other colleges did. The field of engineering with the largest number of Negro students enrolled was electrical engineering.

More companies visited the college campuses to recruit graduating engineering students than there were graduates. These companies hired almost all of the graduates. The Negroes among the graduates were readily employed.

There is a higher percentage of Negro women students among the Negro engineering students than there is of white women students among the white engineering students.

Most of the deans were encouraging in their comments regarding Negro engineering students. Many stated that they could see no special placement problems or other problems if more were to enroll in engineering courses.

The information from Negro engineering students was supplied by juniors and seniors at Howard University. They were all male with an average age of 25 and were enrolled in the civil engineering, electrical engineering, and mechanical engineering programs. The largest group was studying electrical engineering.

The Howard students answered that they chose engineering as a career, and their field of engineering as well, on the basis of interest. Most of them stated that they would choose an engineering career a second time if they had the chance to do it all over again, and they based this decision, too, on the interest that they have in engineering.

There was not a clear pattern as to who had influenced the students most in their choice of engineering as a career. Some were influenced by their relatives, some by high school personnel, and a group of about the same size stated that they were influenced by no one in particular.

Most of the high school counselors throughout the United States who answered the questionnaire thought that Negro youth chose engineering as a career less frequently than other youth. They ascribed this to varied reasons. It was suggested that in order to increase the number of Negroes in engineering, attention would have to be paid to the guidance programs, to the dissemination of information to the parents of Negro youth, to improving secondary training for Negroes, to motivating the youth, and to providing financial aid for those capable youth who are interested in entering the profession.

Almost all of the counselors thought that qualified Negro youth should be encouraged to prepare for engineering careers, and they gave as their main reason the better employment opportunities of the present time.

It is interesting to note that while almost all of the counselors thought that qualified Negro youth should be encouraged to prepare for engineering careers, about one-fifth of them had given "lack of opportunity" as the answer to an earlier question which asked them to explain the apparent lack of interest in engineering. It may be that the counselors thought that the opportunities for Negroes in engineering are increasing, or it may be that they thought that Negroes should prepare for the profession even though their opportunities were restricted.

The comments of the counselors on the guidance of Negroes as related to the current shortage of engineers lacked uniformity. Most of the comments concerned some inadequacy in high school guidance programs. Most frequently cited was the need for current occupational information for Negro youths early in their high school careers. Other suggestions made were that engineering colleges should publicize the lack of discrimination in their programs, that business firms should be re-educated to the advantages of employing Negro engineers, and that the cultural level of the Negro community be raised so that its members would have a more adequate background for a career in the professions.

Each of the engineering and professional societies in the fields covered by this study freely admits Negroes to membership. There are no statistics available as to the number or distribution of Negroes in the societies.

Conclusions

The evidence supports the conclusion that discrimination against Negroes in engineering has decreased to the point where, today, Negro youth who have the interest and aptitude should be encouraged to prepare for an engineering career. Adequate training and employment opportunities are available in many places throughout the United States. The door is open to full membership in the profession.

Although in each of the sources of information all or almost all gave responses that were favorable to the entry of Negroes into engineering, there were some isolated individuals who thought otherwise. In a statistical study it must be remembered that the statistics represent individual people. In this case, if the experiences of future Negro engineers parallel those of the present Negro engineers, there would be a small minority of the engineers who would feel that full employment opportunities had been denied to them because of their race.

The study was national and the favorable data came from widespread sources, but it did not establish the fact of equal educational or employment opportunities throughout the various regions of the United States.

The study was made at a time of high employment when a shortage of engineers existed in the United States. It is easier for minority members to obtain employment during a time of high employment and labor shortage. However, with the increasing mechanization of industry, the trend today is toward the employment of a greater and greater number of engineers per capita.

The study has shown that Negro men have entered accredited engineering colleges from 1899 to the present time. These men have succeeded in college, in industry, in government, and have achieved full professional status in their field. They had a uniformly high degree of interest in engineering which helped them to succeed in spite of unfavorable conditions. The well advertised and attractive employment opportunities of today may cause Negro youth to base their vocational choices more on employment opportunities than on their interest in the field. The study has not demonstrated that success in engineering can be achieved unless aptitude is coupled with interest.

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APPENDIX B

Opportunities for Negroes in Engineering —A SECOND REPORT

ROBERT KIEHL

IN A PREVIOUS article [2] the present writer reported on a study [3] conducted on the opportunities for Negroes in engineering during 1955 and 1956. The findings were based on information collected from four sources: industrial and commercial enterprises, Negro engineers, civic and governmental organizations, and educational and professional institutions. The study had been inspired, in part, by Eli Ginzberg's book, *The Negro Potential* [*1*], in which attention was called to the striking underutilization of the Negro in skilled work and in professional employment.

The investigation being reported in this article is a follow-up on part of the 1955–1956 study. It is a survey made six years later of the number of Negro students in engineering colleges. The purpose of the follow-up was to determine if there has been an increase in the number of Negroes preparing for the engineering profession.

The 1955–1956 study showed that the door was open to full membership in the engineering profession for Negroes because of the opportunities in education, employment, and in the engineering and professional societies. The data suggested that when Negro youth have the interest and aptitude for engineering there is no reason not to encourage their seeking engineering careers. They also showed that the proportion of Negro to other engineering students dropped successively from the freshman to the senior year. In addition they showed that proportionately there were far fewer Negroes in the engineering profession than there were Negroes in the United States and they suggested that to this extent Negroes were not being fully utilized as a source of engineering manpower.

The investigation now being reported utilized questionnaires that were sent to the deans of each of the 164 engineering colleges in the United States that are accredited by the Engineers Council for Professional Development. Enrollment figures for each college as reported in the *Journal of Engineering Education* 1962 Yearbook and Membership Directory [*4*] were supplied to each dean. The deans were then asked to indicate how many of the listed students were Negroes. The deans were also asked to list the branches of engineering being studied by their Negro students, for some placement information, and to indicate the number of Negro women engineering students.

The response by 93 per cent of the engineering college deans was most gratifying. These represented colleges in each of the 50 states. Many of the deans could not supply the detailed information that was requested because college policy or state fair employment practice legislation prohibited keeping records that indicate the race of students. However, there were 66 colleges whose deans did supply detailed information both for the 1955–1956 study and for the 1961–1962 study. The statistics that are shown in TABLE I are a comparison of the figures from these 66 engineering colleges.

An examination of the tabulation shows that there has been a marked increase in the numbers of Negro engineering students in the years spanned by the surveys. This amounts to a 48 per cent increase over-all in Negro students in the 66 colleges reported. It also shows that there is a proportionately greater number of Negroes enrolling in engineering and a proportionately greater

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TABLE 1

ENROLLMENT OF DAY COLLEGE STUDENTS IN 66 ECPD ACCREDITED ENGINEERING COLLEGES SHOWING THE RATIO OF NEGRO TO ALL OTHER STUDENTS AND COMPARING THE FIGURES FOR THE YEAR 1955–1956 WITH THOSE OF 1961–1962

	1st Year	*2nd Year*	*3rd Year*	*4th Year*
1955–1956 ratio of Negro students to all other students	1 to 102	1 to 168	1 to 210	1 to 236
1961–1962 ratio of Negro students to all other students	1 to 92	1 to 94	1 to 97	1 to 102

Some information was also received on fifth year students but the numbers involved were too small to be significant.

number staying for the full four-year curriculum. The reasons for these enrollment trends and subsequent attrition rates were not within the scope of this study.

The total number of Negro undergraduate day students reported by the 66 deans for 1961–1962 was 577. Thirteen of these students are women. There were additional deans who stated that their institutions had Negro undergraduates but who did not supply actual registration figures. In all, 78 deans from colleges in 37 states reported that there were Negro students at their institutions. The deans reported their Negro students to be enrolled in the various engineering branches according to the following percentages:

Chemical Engineering	2
Civil Engineering	14
Electrical Engineering	49
Industrial Engineering	1
Mechanical Engineering	27
Mining Engineering	0
All Other Branches	7
	100

These percentages approximate the percentages of all students among the branches as shown in the *Journal of Engineering Education* 1962 Yearbook.

Each questionnaire included a request for comments by the deans. Most of the comments had to do with the placement of Negro engineers and all of these except one were encouraging to Negroes contemplating engineering careers. "Excellent possibilities with little discrimination," "We would like more good Negro students in engineering. There is no placement problem," " . . . well qualified Negro graduates in engineering will always have excellent job opportunities in that field," and "Believe that opportunities in science and engineering are excellent for Negroes" are examples. The one comment that was in part unfavorable was from the dean of a North Central state college: " . . . there are great opportunities for highly qualified Negroes in government laboratories and in universities. Industries are closed."

One would hardly expect the Negro with his economic and educational background to be represented in the engineering profession in the 1 to 10 ratio that approximates his ratio to non-Negroes in the total population of the United States. However, the relatively small number of Negro students in engineering colleges has increased by almost 50 per cent in six years. Of as great significance is the improvement in the attrition rate of Negroes during the four-year college period. These findings, coupled with the predominantly encouraging comments by the deans of the engineering colleges, point to even greater educational gains and opportunities for the Negro in engineering.

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APPENDIX C

A MINORITY GROUP AS A SOURCE OF ENGINEERING MANPOWER

ROBERT KIEHL

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The shortage of engineers of the past several years has been one of the major concerns of the United States. The Engineers Joint Council's Engineering Manpower commission has published a *Newsletter* (1) since 1951 that is devoted largely to this shortage and how to alleviate it. Wolfle's *America's Resources of Specialized Talent* (2), the National Manpower Council's *A Policy for Scientific and Professional Manpower* (3) and The Educational Policies Commission's *Manpower and Education* (4) are some of the works that have dealt with such manpower problems.

The consensus of all sources seems to be that the solution to the problem of supplying engineers is not simply to entice qualified men away from other professions or high-level occupations. It is, rather, that we make the best possible use of the total qualified manpower that this country possesses.

In 1956 Eli Ginzberg's (5) *The Negro Potential* was received with great interest. Ginzberg called attention to the striking under-utilization of the Negro in skilled work and in professional employment.

Starting in 1954 and running through 1956 this author conducted a study (6) of the opportunities for Negroes in engineering. Part of this study—a doctoral dissertation at Rutgers, The State University—supplied the data on which this article is based. The data support the theory that a partial solution of the engineering manpower shortage could come from encouraging more qualified Negro youth to enter the engineering profession.

The U. S. Census figures for 1950 (7) showed that there was one Negro engineer in the United States for approximately 300 white engineers. If the ratio of Negro engineers to white engineers could be brought closer to the one in ten that Negroes represent in our total population, many additional engineers would be available to help alleviate present or future engineering manpower shortages.

Three questions remain to be answered before it can be concluded that Negroes will be of appreciable help in serving our society as engineers. They are:

1. Are there training opportunities for Negroes in our accredited engineering colleges?
2. Are there employment opportunities for Negro engineers?
3. Can today's Negro achieve full professional status in engineering?

Training Opportunities

In June of 1956 a request for information on the numbers of Negro students at each institution was sent to the deans of the 150 ECPD-accredited engineering colleges. The deans were most cooperative in the number and nature of their responses. Of the 150 questionnaires, there were 143 (95%) returns, representing at least one college in each of the 48 states.

Many of the deans stated that it was contrary to college policy, and sometimes to state laws, to keep records according to race; consequently they were handicapped in reporting.

Some therefore supplied information based on the memories of their department heads or on the personal knowledge of registration officials. The most important single fact emerging from the data was that there were Negro students in attendance in at least 73 of the engineering colleges.

There were 108 deans who listed actual numbers of Negro students totaling 454. These students were not distributed evenly among all four years of college. There were 242 (or one to every 152 other students) in the freshman year. The number decreased progressively each year. In the senior year there were 43 such students (or one to every 364 other students).

The questionnaire to the deans contained space for comments. All but two of the many who commented were favorable to the idea of more Negroes entering the engineering profession. An example of the remarks was, "I see no problem, and I can envision no problem." Another stated, "Of course Negroes should be utilized to the fullest extent of their training and capabilities, whether there is a shortage or not." A third stated:

> We would welcome more qualified Negro applicants than we are getting and, if such applicants were forthcoming, they would be admitted, educated, and placed in exactly the same fashion as are all other potential students.

Some of the deans directed their comments to the help that Negro engineers could be in solving manpower shortages. Most were of the opinion that there is a Negro potential that could and should be used. As one dean pointed out, "It could be an important supplement to the engineering manpower shortage if more Negroes would study engineering and enter the profession." Another said: "Any qualified engineer, regardless of race, color, or creed, should be utilized."

The comments quoted above were typical. The two deans who were not enthusiastic, however, expressed the opinion that there would be placement problems with Negro engineering graduates.

Employment Opportunities

Information on employment opportunities for Negro engineers was obtained from industrial firms and from the employment records of Negro engineers. Ninteen companies—the largest in their respective manufacturing fields—were asked for information concerning the number of Negro engineers employed. All nineteen of the companies replied. It was learned that among firms that had over 26,000 engineers, there were between 40 and 65 Negro engineers employed.

Comments of the employers were of three general types. First, the firms emphasized that they kept no record of the race of employees. Second, they stated they were willing to hire Negroes. Third, there was a lack of qualified Negro applicants for the engineering positions.

To supplement this direct response, a second industrial source of information on the employment opportunities of Negro engineers was used. "Help Wanted" advertisements in the newspapers of the 41 largest United States cities were surveyed, and questionnaires were sent to each of 102 firms that had advertised for engineers on the same day across the country. These were smaller firms than those in the first group. The same questions were asked of this group of firms, but, possibly because in this case the replies were anonymous, the information returned was more detailed.

Of the second group of employers, 56 (55%) replied that they employed

15,500 engineers, 81 of whom were Negroes. The comments of these employers were similar to those of the first group. Almost three-quarters of those who commented were favorable to the employment of Negro engineers. Many wrote of the lack of Negro applicants.

Although the total number of Negro engineers employed in both groups of companies was not large (about one for each 500 white engineers for the first group of companies, and one for every 200 in the second group), it is significant that 50% of all of the companies queried were actively interested in Negro engineers as employees. That is, 28% of the companies employ Negro engineers, and 22% more wish to employ them but do not receive applications for employment from them.

The other main source of information on the employment opportunities is the employment records of Negro engineers themselves. A list of 140 such men was obtained from the secretaries of two associations of Negro engineers. Almost all of these men had received one or more engineering degrees between 1899 and 1954. They were revealed as having successful careers in private industry, Civil Service, and in teaching. Every single one of the respondents answered that he would advise qualified Negro youths to choose an engineering career today.

Professional Status

In order to learn if Negro engineers had achieved full professional status, it was first determined that Negroes are members of the chief engineering and professional societies.

The second source of information on the professional status of the Negro in engineering came from answers that the Negro engineers themselves gave to such questions. For 76 Negro engineers who answered that their work had professional status and four who answered that their work was professional "in part," there were only five who stated that their work was not at the professional level. The men who claimed professional status estimated that they achieved this level of work in an average time of less than three years.

Apparently, then, the door *is* open to full membership in the engineering profession for members of the Negro race. Further, there are both training and employment opportunities available at the professional level for Negroes. The members of the minority group therefore represent a potential source of manpower for the alleviation of present or future shortages of engineering talent.

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APPENDIX D

Section B: Negro Engineers and Students Report on Their Profession

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TWENTY-TWO YEARS AGO LEWIS K. DOWNING[1] OF HOWARD UNIVERSITY reported his views in these pages on the favorable career opportunities for Negroes in the profession of engineering. In the twenty years that followed this prophetic article little research on opportunities for Negroes in engineering has been reported in journals devoted to Negro education, to guidance, or to manpower problems.

In 1956 a major study[2] was completed that brought into sharp focus the underutilization of the Negro throughout the entire range of occupations—including the professions. The following year nation-wide research[3] on the opportunities for Negroes in engineering was reported in a doctoral dissertation at Rutgers, The State University. The reports of Negro engineers and students on their profession are taken from the Rutgers study of 1957. The views of those Negroes who are practising or studying engineering must be considered as having special relevance.

PRACTISING ENGINEERS

Through the cooperation of officials in the Eastern Technical Association and the National Technical Association the names of 140 practising engineers were obtained. These men were chosen for the study not because they were members of the two associations but because the associations made it possible to obtain the names of Negro engineers. Questionnaire returns were received from 67 per cent of this group.

All of the engineers who responded are male. Their ages ranged from twenty-five to seventy years at the time of the survey and the average of the total group was between forty-one and forty-two years. Almost all were college graduates. They received their undergraduate engineering degrees between 1899 and 1954 from a total of twenty-seven colleges that are located in thirteen states and the District of Columbia.[4] Twenty-five of the engineers reported that they had received one or more graduate degrees. Master's degrees were earned in colleges and universities in six states and in the District of Columbia.[5]

Electrical Engineering with twenty-nine graduates and Civil Engineering with twenty-eight graduates represented the chief fields of specialization. Mechanical Engineering was the next most popular field with eleven graduates.

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[1] Lewis K. Downing, "The Negro in the Profession of Engineering", *Journal of Negro Education*, 4:66–69, January 1935.

[2] Eli Ginzberg, *The Negro Potential*, New York: Columbia University Press, 1956.

[3] Robert Kiehl, "Preparation of the Negro for his Professional Engineering Opportunities". Unpublished Doctor's thesis, Rutgers, The State University, New Brunswick, 1957.

[4] Arizona, Illinois, Indiana, Iowa, Kansas, Massachusetts, Michigan, Montana, New Jersey, New York, North Carolina, Ohio, Pennsylvania, District of Columbia.

[5] Iowa, Massachusetts, Michigan, New Jersey, New York, Pennsylvania, District of Columbia.

Eighty-six of the engineers gave detailed employment records that showed the following breakdown by type of employer: private firms, 37; civil service, 35; educational institutions, 13; and U. S. Navy (officer), 1.

When considered by the functions of engineering the records showed the following employment: Research and Development, 20; Design, 14; Production or Construction, 11; and Sales, none.

The questions that the engineers were asked to answer included the following:

1. Why did you choose engineering? A number of reasons were listed by one or two men each. These included the "challenge" of engineering, or the "desire to follow my father's work", or the fact that engineering is considered "a good basis for work in many fields", and that of wanting "to participate in the physical development of our society". However the most striking result of the answers was the comparison of the numbers of engineers who gave "interest" as their reason with those who gave "opportunity" as the reason. A total of fifty-five men answered that they chose the field on the basis of their interest in it. Only three responded that they chose engineering because of the opportunities in the field.

2. Would you choose a technical career if you had the chance to do it all over again? This question was answered by eighty-seven men, seventy four of whom stated that they would choose engineering a second time. Eleven men answered that they would choose some other profession if they had the opportunity. Two men were not certain.

3. Would you advise qualified Negro youths to choose engineering careers today? Every one of the engineers answered this question affirmatively. Fifty-five gave as the reason the current opportunities which they attributed to the shortage of engineers or the changing attitude towards the employment of Negro engineers. Other expressed reasons were that engineering presented a "challenge", that it is "a good field for anyone", that in engineering "a man could be of maximum use to society", and because of "the need for Negroes to gain prestige in this profession for the betterment of their position in society".

4. Do you consider your work to be of professional status? (Is the training required for your present work of college level?) Seventy-six of the engineers thought that their work was of professional status and four stated that it was professional "in part" or "at times". Five men stated that their work was not at a professional level. Two of these men were employed in private industry, one in civil service, one taught in a high school, and one was a naval officer.

Comments on the opportunities for Negroes in the engineering profession were made by sixty-eight of the engineers. Almost all of the comments were favorable regarding the opportunities for Negroes in the profession but there were a few reservations. Rather than attempt to list or tabulate the comments some representative ones are selected.

One engineer wrote: "Opportunities for Negroes are mushrooming—so therefore they should not be afraid to venture out in the search of these opportunities." Five respondents expressed their enthusiasm merely by terming the opportunities "unlimited" or "practically unlimited". Of special interest is the case history of one man who said:

> Opportunities in private industry have increased 100-fold in the past four years and are definitely still on the upswing. . . . Out of a class of 35, I, the only Negro, was the only one without a job (1952) and when in two months I found one, it was at a menial wage. In a short while, however, my status approached that of other engineers with my experience. . . . It is my opinion that a slackening of demand will not negate these advances and when the demand for engineers has lessened, we will already have been accepted as qualified men in the field.

Several of the respondents mentioned the growing demand for engineers as the chief cause of the improvement in employment opportunities. As one respondent expressed it, "The profession is growing so and industries expanding until all are looking for engineers (period) whether they be blue, black, or green." Another man wrote:

> I would guess that things are getting better because of the needs of this field. There are not enough Negro engineers available to saturate the liberal offices and so to build up pressure on those slow to conform. One of the big problems seems to be to break down the feeling that engineering is not a field for Negroes.

Two other comments in the same vein:

> Any Negro with any technical leanings should go into the engineering profession. The trend today is definitely in this direction. There is an immediate demand for all types of engineers today and for many years to come. The Negro youth now attending high school should be enlightened to such.

* * *

> The acute shortage of engineers in all fields has awakened organizations utilizing engineers to the vast un-used potential of Negroes in this endeavor. Many of these organizations whose doors were closed to the technically trained Negro just prior to World War II, have changed their policies somewhat. This change of policy has, to a considerable extent, erased the difficulty that the Negro had previously experienced in securing employment in the engineering profession. The future outlook appears to be even brighter.

Many of the comments were characterized by distinct optimism such as:

> I feel opportunities are now open regardless of race in nearly all sections of the country. The pattern has been established so that in a very short time all restrictions will be eliminated.

* * *

> It is my belief that the field of engineering offers the Negro the greatest economic opportunities. In fact it is the one field that is almost free of racial discrimination.

Another wrote:

> I am seeing opportunities constantly being opened due to the increasingly important role technicians are playing in our daily affairs. In a left handed way—thanks to Russian technical emphasis—we can no longer indulge in the luxury of widespread technical discrimination. Certainly the education is available and this is the time to take advantage of the opportunity to use it and thus gain the "knowhow" for industrial and business applications by which all Negroes will eventually benefit.

Four of the engineers who cooperated in the study took rather pessimistic views. None of these men went so far as to advise Negro youth to stay out of engineering. However, the weight of their comments is sufficient to impress upon a Negro youth contemplating engineering as a career that he may not be able to compete on a completely equal footing with other engineers. As one engineer said:

> Conditions could be much better. The chance for upgrading is still poor. Read the Commonwealth of Pennsylvania re-

> port on race relations in Pennsylvania and you will see what I am talking about.

An engineer who received his B. S. in 1949 and his M. S. in 1955 insisted:

> The true picture is not presented. Only demand helps us. There is much resistance everywhere we are hired. Most large companies won't hire me. Some offer $6,000. You don't supervise or travel for the company at that level. I qualify for $12,000 and earn $9,000 so you see how they get rid of me. My only hope of getting more is to go to some isolated spot out west.

And a third individual declared that "provided the young man has the guts, mental background, and wants to work, he can and will go places," but "there are plenty of hard, hard cores of bias to crack." The fourth thought that though the shortage of qualified personnel made it possible for the Negro engineer to secure employment, "Prejudice, however, is still most strong and bitter in the technical field. . . . The going in the short future should be rough."

Many of the comments that were received from the engineers emphasized that the shortage of engineers was a factor that greatly aided Negro engineers to find employment. In the year that has elapsed since the data were collected there has been evidence of a lessening of the shortage of engineers. This brings to mind the possibility that a young man who now undertakes engineering training might not be able to find professional employment on graduation. Two points should be kept in mind. The first is that there is an ever increasing ratio of engineers to other industrial workers. The second is that men with engineering training are suited for many different types of work that are only partially related to the technical aspects of engineering.

ENGINEERING STUDENTS

The only readily available and sizable group of Negro engineering students are those at Howard University. With the cooperation of officials at the university the names and addresses of the junior and senior engineering students in 1956 were obtained and information was sought by means of questionnaires. There were seventy-one students in this group, 80 per cent of whom supplied information for the study. All of the students were male. Thirty-one were juniors and twenty-four were seniors. Their ages ranged from nineteen to thirty-nine years and the average was 25 years.

The questions asked of the students were essentially the same as those asked engineers.

Why did you choose engineering as a career? First there were the twenty-three students whose answers stated that they chose engineering because of their interest in or liking for engineering. Ten students stated that they chose engineering because of the opportunities that it afforded them. Apparently interest outweighed opportunity in the eyes of these youths at the time that they made the choice of their occupation.

There were seven responses from young men for whom engineering satisfied both the motives of interest and opportunity. These gave such answers as "Interest, and to make money," "Interest and desire for security," and "Opportunity and enjoyment." Two of the students emphasized creativity. Their answers were "desire to create" and "Challenging opportunities to express inventiveness and creativity."

Throughout the answers of the students there were responses of an altruistic nature. Apparently some of the young men were civic minded on a broad scale. Two such answers were included among those to the question of choice of engineering. One gave his reason as "Significance to the world," and the other's response was "Challenging field through which the whole human race can be helped."

Would you advise other qualified Negro high school graduates to choose engineering careers today? All of the engineering students said "yes" to this question although one made his answer provisional—depending on the interest of the high school student.

In the earlier question on choice of engineering as a profession the students had given interest as their main reason. In this question regarding advice to high school graduates the balance was tipped in the other direction with thirty-one giving opportunities as the reason for their advice and only six mentioning interest. It may be that the students assumed that only those interested in engineering would be likely to enter the field.

Five students explicitly indicated that they recommended the profession because they thought that there was little or no discrimination connected with it. For example, one spoke of being "limited only by ability and qualifications."

Would you choose an engineering career if you had the chance to do it all over again? The answer was "yes" from all students except one. A junior backed up his "no" with the comment that there was "too much work in school."

In the answers to this question the importance of interest over opportunity in the opinions of the students was again demonstrated. Thirteen of the answers stressed that their interest in or liking for the profession was the deciding factor. Four of the students gave the opportunities in engineering as their reason.

Other comments are of interest: "Expectations fulfilled," "Previous convictions unchanged," and the "Interesting challenge" (stated by two students) are examples. Two of the students seemed to pass on a word of advice to others in their comments "I would be better prepared before coming to college," and "I only wish I had prepared a little better in high school."

Altruistic comments are to be found in the answers to this question also. One man said he looked forward to being a "contributor to progress of the machine age" and another said "I have found exactly what I had hoped for, and that is an opportunity to really contribute something to mankind."

One respondent seemed to epitomize the spirit of many of the other comments when he wrote: "Because as an engineer I feel that I can get good pay for doing what I like most to do."

SUMMARY

The data received from practising engineers and from engineering students is overwhelmingly favorable for the employment of Negroes in the engineering profession. Both students and practising engineers like their profession. They chose it on the basis of interest and would choose it again for the same reason if they had the chance to do it all over again. In effect they say "Come on in—the water is fine" as they advise others to follow them. They base this advice on current employment opportunities rather than on interest.

It should be noted that the engineers

and the students who have considered themselves happy and successful in their profession are men who chose that profession on the basis of their interest. When these same men recommend the profession to others they do so on the basis of employment opportunities. It would be well to remember that those who have succeeded in the past and who are succeeding now are men who were drawn to their profession by their strong interest in it.

The data from engineers and students which have been used in this article are taken from "Preparation of the Negro for His Professional Engineering Opportunities", by the author and cited previously. Other sources of information on opportunities for Negroes in engineering in the cited study include industrial and commercial enterprises, the state Fair Employment Commissions, the local offices of the Urban League throughout the United States, the headquarters of the National Association for the Advancement of Colored People, the deans of the accredited engineering colleges in the United States, high school counselors, and engineering and professional societies. Data from all of these sources point to the conclusion that discrimination against Negroes in engineering has decreased to the point where Negro youth today who have the interest and aptitude should be encouraged to prepare for an engineering career. Adequate training and employment opportunities are available in many places throughout the United States. The door is open to full membership in the profession.

APPENDIX E

Foundation
FOR THE ADVANCEMENT OF GRADUATE STUDY IN ENGINEERING

October 13, 1969

Twice in the past twelve years I have completed studies concerning Negroes in engineering. Now as Professor Emeritus of the Newark College of Engineering I am conducting a third, broader and deeper study which is entitled "Opportunities for Blacks in the Profession of Engineering" on which I need your help. This current study is being supported by a grant from the U. S. Department of Labor to the college's research foundation.

In addition to providing current information for manpower planners in education, in engineering societies, in industry, and in state and federal governments, the findings of this study will have special relevance for those who provide guidance to black youths.

I hope you will be able to have the enclosed short questionnaire completed and a copy returned to me in the envelope that is provided. The second copy is for your files. Information that you supply will be held in strict confidence by me. A copy of the generalized findings will be sent to you if requested.

Sincerely,

Robert Kiehl

NEWARK COLLEGE OF ENGINEERING / 70 SUMMIT STREET ROOM 214M / NEWARK, N. J. [illegible]

APPENDIX F

BLACK COLLEGE STUDENTS IN FIRST ENGINEERING DEGREE PROGRAMS

(List Bachelor of Technology students in answer to question #3 only)

1. In column one list number of all 1st engineering degree DAY students. In column two list number of black 1st engineering degree DAY students.

	Column One All Students	Column Two Black Students
1st year		
2nd year		
3rd year		
4th year		
5th year		

2. What is your total number of all students enrolled in 1st engineering degree DAY and EVENING programs?__________

   Please indicate the enrollment figures of black 1st engineering degree students (DAY and EVENING together) by branch of engineering.

Chemical	________	Mechanical	________
Civil	________	Mining	________
Electrical	________	All Other	________
Industrial and Mgt.	________		

3. How many students are enrolled in Bachelor of Technology programs?______
   How many of these are black?________

4. In question #2 how many of the black students listed are women?_________

5. Please use this space for any comments you may have on blacks in engineering education and employment.____________________________________

____

____

____

____

Name of Institution______________________________

Signed______________________________

Title______________________________

THANK YOU FOR YOUR HELP.

Dr. Robert Kiehl, Foundation for the Advancement of Graduate Study in Engineering, Newark College of Engineering, 70 Summit Street, Room 214M,

APPENDIX G

BLACK STUDENTS IN TWO YEAR ENGINEERING TECHNICIANS PROGRAMS

1. In column one list number of all students in engineering technician programs.
   In column two list number of black students in engineering technician programs.

	Column One All Students	Column Two Black Students
1st year	____________	______________
2nd year	____________	______________

2. Please list the titles of the divisions of engineering technician training (such as "electrical engineering technician") and indicate the number of black students enrolled.

Name of Program	Number of Black Students Enrolled
_________________________	__________
_________________________	__________
_________________________	__________
_________________________	__________
_________________________	__________

3. How many of your black students are women?____________________

4. Please use this space for any comments you may have on blacks in engineering technician education and employment.

____

____

____

____

Name of Institution__________________________

Signed__________________________

Title__________________________

THANK YOU FOR YOUR HELP.

Dr. Robert Kiehl, Foundation for the Advancement of Graduate Study in Engineering, Newark College of Engineering, 70 Summit Street, Room 214M, Newark, New Jersey 07103

APPENDIX H

Foundation
FOR THE ADVANCEMENT OF GRADUATE STUDY IN ENGINEERING

Twice in the past twelve years I have completed studies concerning Negroes in engineering. Now as Professor Emeritus of the Newark College of Engineering I am conducting a third broader and deeper study which is entitled "Opportunities for Blacks in the Profession of Engineering" on which I need your help. This current study is being supported by a grant from the U. S. Department of Labor.

There are many reasons why information from recent graduates like you is important and will be useful. Most importantly, I think, it will provide information on your type of career to youths who follow you.

Please complete a copy of the enclosed short questionnaire and return it to me in the envelope that is provided. The second copy is for your files. The information you send will be held in strict confidence by me. A copy of the generalized findings will be sent to you if requested.

Sincerely,

Robert Kiehl

NEWARK COLLEGE OF ENGINEERING / 70 SUMMIT STREET ROOM 214M / NEWARK, N. J.

APPENDIX I

EDUCATIONAL AND EMPLOYMENT INFORMATION - ENGINEERING GRADUATES
(YOUR REPLY WILL BE KEPT CONFIDENTIAL)

1. Name____

2. Date of birth____________________ 3. Check sex M___, F___

4. High school name and location____________________

5. College(s) attended____________________

6. Degree received____________________ 7. Date of graduation__________

8. Professional field of study (such as electrical engineering)__________
____

9. Number of interviews at graduation_____, Number of job offers rec'd.____

10. Name and address of employer____________________

11. How did you find out about this job?____________________

12. Brief description of work performed____________________
____

13. Basic yearly salary____________________

14. Are you satisfied with your job? Yes_____, No_____
    a. What do you like best about your job?____________________
    ____
    b. What don't you like so well about your job?____________________
    ____

15. How much engineering education is required to perform your work?
    Four years of engineering college or more__________
    Some college?__________
    Other? (Specify)____________________

16. It will be very helpful if you will list any comments you may have on employment opportunities for black engineers____________________
____
____
____
____

THANK YOU FOR YOUR HELP.

Dr. Robert Kiehl, Foundation for the Advancement of Graduate Study in

APPENDIX J

EDUCATIONAL AND EMPLOYMENT INFORMATION - TECHNICAL INSTITUTE GRADUATES
(YOUR REPLY WILL BE KEPT CONFIDENTIAL)

1. Name____

2. Date of birth____________________ 3. Check sex M____, F____

4. High school name and location____________________________

5. Technical institute(s) attended____________________________
   Number of years____________________________

6. Diploma or certificate rec'd.____________ 7. Graduation date________

8. Field of technician training, such as electrical engineering________
   ____

9. Number of interviews at graduation_____, Number of job offers rec'd.______

10. Name and address of employer____________________________

11. How did you find out about this job?____________________________

12. Brief description of work performed____________________________
    ____

13. Basic yearly salary____________________________

14. Are you satisfied with your job? Yes_____, No_____
    a. What do you like best about your job?____________________
    ____
    b. What don't you like so well about your job?________________
    ____

15. Is the level of your work about right for the length of time you studied in your technical institute?____________________

16. It will be very helpful if you will list any comments you may have on employment opportunities for black engineering technicians.
    ____
    ____
    ____
    ____

THANK YOU FOR YOUR HELP.

Dr. Robert Kiehl, Foundation for the Advancement of Graduate Study in Engineering, Newark College of Engineering, 70 Summit Street, Room 214M.